73® Amateur Radio Today

AUGUST 2003
ISSUE #513
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Parts Sub Like a Pro

Clamp-on DC Ammeter

How to Check Transistors

Review: MFJ Paddle

Going to Goa

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73 Amateur Radio Today

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QRX . . .

Death, Taxes, and the Phone Company

Well, some are calling it a new way for the telephone company to try to communicate with the dearly departed. A resident of the town of Auburn, Massachusetts, died in December of 1997 at age 60. He was buried at the nearby Hillside Cemetery. So it was quite a surprise for the Cemetery Superintendent to receive a bill addressed to the deceased at his graveside.

Even more shocking was the amount of the bill from Sprint. It was for 12 cents. That's right: A big 12 cents, and it included a 10 cent charge for a call placed on February 16, 2003 — a call that the phone company claims was made five years after the man had departed from his life.

Well, the bill has been handed over to the Auburn Town Clerk. She says that she will hold on to it for a while.

Continued on page 6

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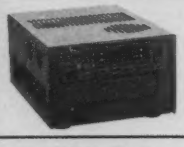

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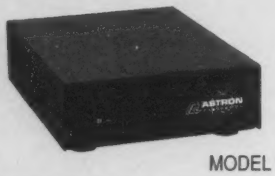

MODEL SS-18

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-10	7	10	1¼ x 6 x 9	3.2
SS-12	10	12	1⅝ x 6 x 9	3.4
SS-18	15	18	1⅝ x 6 x 9	3.6
SS-25	20	25	2¾ x 7 x 9⅝	4.2
SS-30	25	30	3¼ x 7 x 9⅝	5.0

MODEL SS-25M

DESKTOP SWITCHING POWER SUPPLIES WITH VOLT AND AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2¾ x 7 x 9⅝	4.2
SS-30M*	25	30	3¼ x 7 x 9⅝	5.0

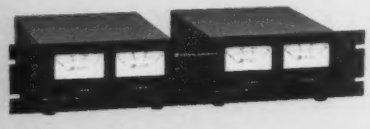
MODEL SRM-30

RACKMOUNT SWITCHING POWER SUPPLIES

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25	20	25	3½ x 19 x 9⅝	6.5
SRM-30	25	30	3½ x 19 x 9⅝	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3½ x 19 x 9⅝	6.5
SRM-30M	25	30	3½ x 19 x 9⅝	7.0



MODEL SRM-30M-2

2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30-2	25	30	3½ x 19 x 9⅝	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30M-2	25	30	3½ x 19 x 9⅝	11.0

MODEL SS-12SM/GTX

MODEL SS-10EFJ-98

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EF JOHNSON AVENGER GX-MC42
EF JOHNSON GT-ML81
EF JOHNSON GT-ML83
EF JOHNSON 9800 SERIES
GE MARC SERIES
GE MONOGRAM SERIES & MAXON SM-4000 SERIES
ICOM IC-F11020 & IC-F2020
KENWOOD TK760, 762, 840, 860, 940, 941
KENWOOD TK760H, 762H
MOTOROLA LOW POWER SM50, SM120, & GTX
MOTOROLA HIGH POWER SM50, SM120, & GTX
MOTOROLA RADIUS & GM 300
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MOTOROLA RADIUS & GM 300
UNIDEN SMH1525, SMU4525
VERTEX — FTL-1011, FT-1011, FT-2011, FT-7011

NEW SWITCHING MODELS

SS-10GX, SS-12GX
SS-18GX
SS-12EFJ
SS-18EFJ
SS-10-EFJ-98, SS-12-EFJ-98, SS-18-EFJ-98
SS-12MC
SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
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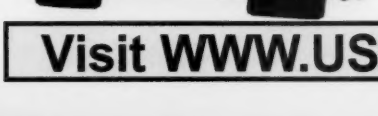

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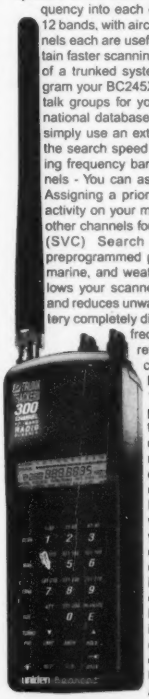

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Frequency Coverage:
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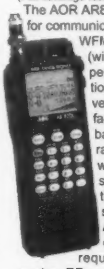

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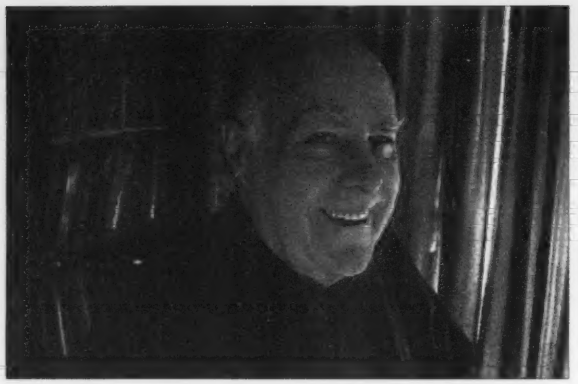

Wise Up & Beat the Odds

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Share the Fun

It's pretty clear by now that the ARRL isn't going to lift a finger to promote the hobby in the media, no matter how bad things get. Do I fault them for this situation? Of course not … if the League members had the slightest interest in keeping the hobby going they'd be raising hell with HQ about it. And they're not. Not a whimper. It's the old boiled frog syndrome.

One thing that would help would be a booklet that could be gotten out to kids explaining what fun they could be having on our ham bands. Somewhere around 95% of the kids today are totally unaware of our hobby. It's degenerated into a hobby almost totally enjoyed by old retired white men.

Most of us few survivors got involved in the hobby as teenagers. Heck, that's when we had the time it took. That was before we got married and worked a 9 to 5 job we hated to make enough money to raise a family. Hamming takes time and money, neither of which are in plentiful supply to most family men.

It was tough enough getting recruits a few decades ago when those few of us surviving were kids, what with the teenage interest in girls and sports. Now we're up against the Internet, Napster, chat rooms, computer games, and 24/7 100-plus-channel TV.

Several times I've asked you to tell me what fun you're having. I'd love to be able to reprint a series of enthusiastic letters in a booklet for teenagers so they'll see what they've been missing.

Today's kids aren't interested in the fun I had 60 years ago building my ham gear. Or my pioneering repeaters, RTTY, SSB, and going on DXpeditions long before they were born. To get kids' attention, we need to explain what fun they could be having today. So, what have you been doing that's fun?

Zzzzzz?

New Tricks

JoAnne Schmuss KD4ODQ just passed her Extra Class exam. Not bad for a 71-year-old. Now, what's all that beefing about the no-code license test? Gimme a break!

Ignorance vs. Stupidity

Learning to read is one thing. Actually doing it, another. Ignorance is a lack of learning. Stupidity is not bothering to learn.

So, where am I going with this?

Toward learning. And, that's not easy. You see, there's a world of difference between learning to read and reading to learn. The main obstacle, once one has an interest in reading to learn, is the high percentage of baloney that's being passed off as nonfiction. The reality is that we're being lied to about so many things.

A couple years ago The Disinformation Company published a 400-page 9x12 book, *You're Being Lied To,* a wonderful collection of exposés. See [www.disinfo.com]. It's one of the best $20 book investments you'll ever make. Last year they followed with *Everything You Know Is Wrong,* 350 pages and $25.

In my research I've learned that we have been and are still being lied to at every turn.

One of the biggest lies, one that is affecting your and your family's life more than all the others combined, has to do with health. We are being lied to by the medical/pharmaceutical complex, the government, our doctors, the food industry, and on down the line.

Which may explain why I've been such an itch about this in a ham magazine.

The key to good health is pathetically simple. It even makes good common sense. If you want to be healthy, stop putting poisons into your body. What part of not poisoning yourself don't you understand?

I go into the gory details of all the poisons in my *Secret Guide to Health,* 160 pages, $15.

Some, like nicotine, caffeine, alcohol, and refined sugar, are self-evident. The most insidious by far is cooked food. As soon as you cook food it kills the enzymes and vitamins your body needs, but even worse, your immune system treats it as toxic, rushing out the white cells to fight it, lowering your immune system's ability to deal with invading germs, viruses, parasites, cancer, and so on.

The more you're able to change your lifestyle to a raw food diet, the sooner your body will be able to repair the years of damage you've done.

And More Lies

Like the 9/11 attack, Flight 800, Roswell, contactees, the Florida voting machines, Iraq's WMDs, cold fusion being a bust, our school system, cancer and AIDS not being easily cured, milk being safe to drink, global warming, vaccinations safe, the drug war, the Moon landings, Pearl Harbor, Amelia Earhart, one bomb at Oklahoma City, sonograms not damaging babies, cell phones not burning out brain cells, the sun causing skin cancer, crop circles being made by people, the shuttle and space station being of any value, hot fusion having any potential, and so on. Cheesh, what a bunch of lies we're fed … and accept.

Another Cancer Cover-Up

Acres USA published a great interview with Dan Haley, the author of *Politics In Healing.* In his book, Dan gives us the details of ten cases where the AMA has suppressed cures for serious diseases.

Take Dr. William Koch. Seventy years ago he discovered that cancer results when a body's oxidation system is impaired. He developed a way to trigger the body to reverse the process with one injection of glyoxylide. The book explains how he made this substance.

The AMA, anxious to stop this simple cancer cure, tried to buy Dr. Koch out. When he refused, the FDA, under pressure from the AMA, took Koch to court in 1942, and again in 1946, trying to stop

him. But with the testimony of over 200 of his patients who had been cured of cancer with his one-shot treatment, Koch won. So the AMA next went after him through the Federal Trade Commission.

The FTC made life miserable for Koch, so when finally he won their trial against him, he could see that the AMA would never give up trying to stop him and he moved to Brazil.

By an odd "coincidence" the assistant attorney general who prosecuted Koch died of cancer a few months after the trial. Then the head of the FDA office, the FTC prosecutor, and the FTC administrative judge all died of cancer.

The AMA has fought every cancer cure vigorously because cancer is the medical industry's biggest money maker. And never mind the 550,000 Americans dying of cancer every year. The current "accepted" treatments result in a 7% survival rate, making cancer a hugely expensive virtual death sentence.

The casualties are equivalent to three fully loaded 747s crashing and killing everybody on board every day — the main difference being that the plane crashes would make the evening news and the papers.

Today we're seeing the same AMA response to the work of Drs. Comby, Day, Kaali, and others. Nothing has changed.

Turn Down The Heat!

By Gorey, global warming sure hasn't hit New Hampshire yet. Brrr. I can remember when June used to be the hottest month of the year. This summer (?), June 20th came and I still hadn't taken the air conditioner out of the closet. There were a few days when it actually got over 70° and I was able to take my shirt off on my daily walks through our fields to get some sun.

This year Washington, DC, had the coldest February in 25 years. New York got its fourth deepest snowfall since 1869. Baltimore got more snow in February than any other month in recorded history. *Science* reported that the West Antarctic ice sheet has been growing thicker, not melting. The Antarctic has been getting colder for the last 30 years, not warmer.

Sure, the thousands of new volcanoes under the Pacific have heated the ocean, calving some of the Antarctic ice shelves.

The endless spring and early summer rain has resulted in the most fantastic wildflower extravaganza I've ever seen in our fields. How I wish you could have walked through them with me … it's like an endless symphony in beauty. Over twenty kinds of wildflowers, many by the millions. No, make that billions. Daisies three feet high. But then, almost everything grew to three feet high by June … stuff that's normally only six inches.

Weird weather.

Jim McCanney says this is a manifestation of the influence Planet X is having on our sun. Unlike Mark Hazelwood and Nancy Lieder, he's expecting it to arrive in about ten years. Hmm, there's that darned 2012 date again. The sun is erupting with huge solar flares, so something strange is going on. And how about those new government observatories at the South Pole? What are they for? And why the government secrecy? Everything about this is now classified. Highly classified, according to McCanney. I've got his book on *Planet X* available for $18 (#95) Radio Bookshop.

And you've been at a loss for things to talk about?

What Gives?

With the May 15th Planet X deadline passed, and Lieder's June 1st extended deadline too, have we had another Y2K false alarm? The sky hasn't fallen. The Earth hasn't stopped turning. Whew!

So, what, pray tell, is going on? Something is. Like astronomers tell us that Pluto has started moving further away from the Sun and is already 2° warmer. The centuries-old dark spot on Neptune has vanished and a new one is forming. Triton is warming. Jupiter's spot is shrinking and Io is warming. The ice caps on Mars are melting. Earth's gravity field has been changing. The Sun is shooting out record eruptions.

And what's that coming around the Sun that several amateur astronomers have gotten pictures of? See [www.crosswynd.com].

Then there's the Vatican observatory in Arizona that is now being guarded by U.S. troops. How come they need an observatory? Why in Arizona? And what's all the secrecy?

Hmm, yeah, sure, but how are the Red Sox doing?

The Wealthy

They're doing fabulously, thank you. Better than ever! Meanwhile American families have seen their income remain flat through the '80s and '90s, except for the top 1%, where it zoomed from an inflation-adjusted $256,000 to $644,000.

Hmm, how come? That's easy … the wealthy use their money to buy influence and use that influence to make more money. Like the recent tax cuts, for instance.

So, what's next? If history is going to repeat itself, a burst of warfare will waste our energy and money just as it did Holland in the 1700s and Britain in the last century. Think Great Britain, where the sun never set and is now almost irrelevant?

Watch out, you Iranian devils, here we come! Doesn't Syria need fixing, too? Heck, with high-tech wars only costing a few hundred billion, let's have at it. Say, is Libya still a problem? Oh, and let's clean up that nasty Sudan mess.

Coincidence?

Maybe you've read about the 19 world-class microbiologists who were murdered between October 2001 and February 2002. This has been mentioned several times on the Art Bell show, and a reader sent me a newspaper article about it.

Something's going on. Hello, CIA, is that you?

Allen's Alley

We old-timers remember Woody Allen's *Don't Drink The Water.* I saw the play, read the book, saw the movie. The advice is just as good today. Please don't let your family drink tap water. I was reminded by the latest issue of the *Nutritional Health Journal,* which had an article on water. It says that 50,000 Americans die from health problems caused by fluoridated water. A Harvard University study reported that 15% of all rectal and 9% of bladder problems are caused by chlorinated water. And the EPA warns that chlorine causes high blood pressure and may be linked to Alzheimer's. The *Journal* recommends switching to distilled water.

Hey, where have I heard that one before?

It goes on to point out that your cold cereal breakfast was made from genetically modified crops grown on mineral-depleted land, soaked in pesticides proven to be carcinogenic, and fortified with chemicals and preservatives to prevent spoiling in the box. Amalgam fillings are slowly releasing mercury into your body. A Swiss study found that blood levels of mercury were three times higher in Alzheimer's patients. Then there are those prescription drugs, which they report depress your immune system, rob you of essential nutrients and minerals, and lead to such side effects as liver and kidney failure. It also warns against any canned, bottled, or prepackaged foods.

Gee, all the same things I've been trying to get you to believe as you eat your way to an early grave.

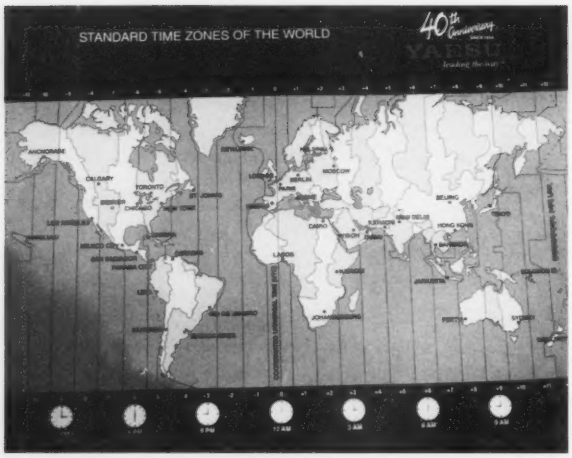
Fluoride Law

Yep, it's now the law in California that every city with more than 10,000 water hookups must fluoridate their

Continued on page 9

QRX

continued from page 1



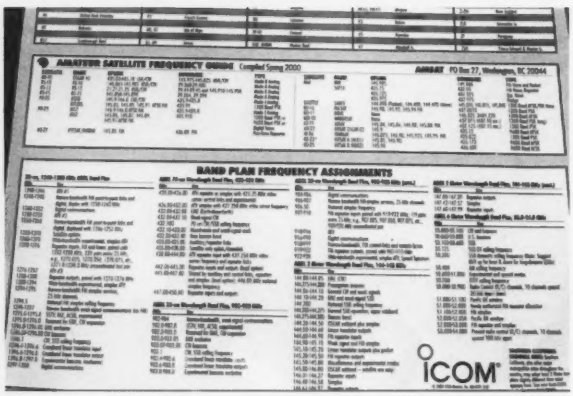


***Photo A.** Three images show just some of the free materials now available to ham class instructors.*

Meanwhile, a call to Sprint Telephone's automated service by a local newspaper in March showed that charges on the unpaid account had inflated. The dearly departed now owes Sprint $3.95. But for the moment the bill remains unpaid. This is because technically speaking, the account is now — quite dead.

The Cemetery Superintendent probably had the best line of all. He told a local newsman that his clients don't usually get mail. Now he wonders if it's time to start putting mailboxes on graveside monuments.

And we must report that it is not true that when this apparent error was pointed out to Sprint, their spokesperson was so quiet you could hear a pin drop.

Free Training Materials for Ham Class Instructors

Amateur radio equipment and accessory manufacturers dazzle hamfest attendees with give-a-way materials in their ham booths. These include world callsign prefix wall maps (Yaesu), glossy stiff-paper color frequency privileges charts (ICOM America), logbooks (Kenwood and Yaesu), VHF/UHF + HF band charts (Kenwood), color frequency privileges chart (Alinco), blank graduation certificates (W5YI), ballcaps and pens (seasonal), *QST Magazine* samplers (ARRL), and huge color radio spectrum charts from DC to daylight (ICOM America).

The ham goes home from the hamfest and puts the map up on the wall and the frequency operating charts under the glass on the radio table.

But imagine the impact of these materials in a classroom for brand-new ham students. The big fold-out electromagnetic spectrum chart is a natural for teaching the relationship between frequency, wavelength, and FCC band allocations. The color privileges chart makes for easy teaching of ham band privileges for various licenses. The logbook includes many pages of reference, including foreign callsign prefixes, and the VHF/UHF color band plan charts make it easy for the instructor to explain satellite and weak signal portions of the 440 MHz band.

"At the ham shows, we are not prepared to give a ham radio instructor a class quantity of these materials — we usually give one or two out to each attendee," explains one ham radio manufacturer, indicating the cost of one of his handouts is over 75 cents each.

"I wish we had time to read all of the requests that come in on E-mail and by letter from ham instructors teaching a class and wanting a quantity of our free literature — we just don't have the manpower to work up this kind of individual instructor program," echo most ham manufacturers when I discuss the need for ham instructors to have quantities of their materials.

For the last four years leading amateur radio manufacturers plus the American Radio Relay League have offered a stockpile of these training materials available to any amateur radio instructor wishing to bring in these training charts and paperwork for their students at the beginning of class. The demand has continuously grown for this service, so effective immediately, a major-size collection of free instructor training materials is available through the W5YI examiners in Dallas, Texas. W5YI: [www.haminstructor.com].

Also available to amateur radio Elmers and instructors is the 30-page Technician class *Instructor's Guide* written by Gordon West WB6NOA. This guide parallels the new July 1, 2003, Technician class question pool, and not only gives the instructor a detailed teaching plan, but also includes pre-study that prospective students will fill out before class begins. The pre-study may also be incorporated within the course as homework. Permission is granted to reproduce the pre-study pages.

There's even more! ICOM America has issued $20 gift certificates that instructors may give out at the completion of their course for new hams to purchase new ICOM amateur radio equipment (valued at over $200). There is also available colorful graduation certificates that the instructor may issue to every student passing the test.

Also available to instructors who register with the W5YI instructor program is the 65-page *QST* special edition magazine from the American Radio Relay League. This special edition of *QST* is specifically printed for new and upgrading amateur operators. Subjects like "How Do Repeaters Work?", "Ham Radio and Public Service," "Getting the Most Out of Handheld Batteries," "PSK 31," and "All About Ham Radio on the Air Awards" are covered in the magazine, and it is available to all instructors teaching classes.

Ham instructors who have traditionally purchased their training materials from Radio Shack™ are finding a new selection of component products in the place where the original entry-level books were once available. Most Radio Shack stores will no longer carry ham radio training materials, yet the materials are still available at discounts for the registered amateur instructor.

A nationwide database is beginning to fill with ham class dates for prospective students to peruse. If you are teaching an upcoming class and want some free publicity, log onto [www.haminstructor.com] and get registered!

Once you are registered as an amateur radio instructor, you will be asked about your upcoming classes and what you may need for class supplies. These supplies will be shipped with your order for training materials, including the Gordon West books, audio cassettes, W5YI and West computer courses, West code cassettes as well as code on the CD computer program, plus other training materials. By popular request, the Forest Mimms book on basic electronics makes a great lab book for beginner students as well as upgrade students.

You may also bring in the new instructor guide that parallels the Gordon West Technician class book where all of the 510 questions have been rearranged for easier teaching. The 29 subgroups of questions for Technician class cuts teaching time by almost 50 percent! Instead of having to jump around the question pool, the new book puts everything in logical teaching order.

Best of all, all of the free manufacturer charts, maps, coupons, and wall-size spectrum charts are immediately available from one location without you, the instructor, needing to contact individual manufacturers and hoping they can get your materials out before your upcoming class.

For questions about the program, contact Gordon West directly, Monday-Thursday, 10:00 a.m.–4:00 p.m., California time, 714-549-5000. Log onto [www.haminstructor.com], or call the toll-free ham instructor phone number, 1-800-669-9594. Your students will appreciate coming into a classroom with plenty of colorful charts and maps waiting for them at their desk seat. Stock up now and see how much easier it is to teach the entry-level Technician class question pool completely rearranged for easier instruction with the Gordon West training materials.

Test Your WX Savvy

What with all the weird weather lately, why not give these posers a try? (Answers at end.)

Continued on page 61

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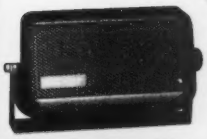

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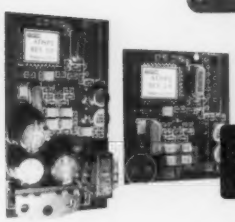

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LETTERS

From the Ham Shack

Anonymous. Thank you very much for your catalog. There are definitely many interesting things that I will order. Unfortunately, I have to wait for payday to come around. This month, I have spent almost everything sending gifts to my wife for her birthday.

That, of course, has priority over everything. By the way, I am not joking when I say "payday." You see, I work for a company called UNICOR, a totally federally owned private corporation (sounds illegal, doesn't it?). At every federal prison, be it high, medium, low, or camp, there is a factory that produces everything from furniture (as we do) to the electrical harnesses for F-16 fighter aircraft.

My job is Head Quality Assurance Inmate and Production Coordinator. It sounds very prestigious, but the truth of the matter is that whenever there is any problem it always falls on my lap. This applies for staff (C.O.'s) or inmates.

I have always worked all my life, and this factory keeps up my management skills and has made me develop considerable people skills. Not everyone is an interested worker.

My salary is defined in the enclosed graph. I am a "P" grade, the highest, plus I have longevity and the advantage of working overtime. I work two shifts, the first from 7:30 a.m. to 3:45 p.m., and the second from 4:00 p.m. to 10:30 p.m. Last month I made $708, but of this half is taken automatically for payment of restitution and fines. My position would be one of at least $100,000 per year, and I assure you that I could justify that amount simply with the improvements made.

Well, many people do not understand that this is a business that the government is running. The 125,000 federal prisoners are backed by a $30 billion budget, plus the revenue from UNICOR — approximately $600 million last year. We supply all of the government agencies.

The status of "mandatory suppliers" for the government may change. Now UNICOR is looking into joint ventures with outside companies that have interest in supplying and participating in government contracts.

This country no longer has "justice" — it has a "legal system."

As always, I make these statements with trepidation because people always consider that a person who is in prison or has had some sort of conflict with the law is simply bitter. There is no reason for the manner in which a person has to face a federal judge. It is proven that once an indictment is issued, it is all over. One should always try to cut the best deal possible.

The scary part of all this is the quality of people who are incarcerated. Now the division is much greater. The amount of drug cases is exorbitant. You would be shocked at the number of prominent businesspeople who are incarcerated and the manner in which all of their constitutional rights have been violated.

The federal government can incarcerate anyone they want. I was a believer in the Constitution, but it has been long dead. If the government wants you, they are going to get you — even if this means that the officers lie in court, fabricate evidence, or simply convict you of "conspiracy," something that is totally impossible to defend oneself against.

These are the facts; hopefully you will never have to face the government in court. Hopefully you will never be requested to do something for them that is illegal. Hopefully your assets will never be used against you to prove that there had to have been, to some degree, and within all probability, an illegal act in your past.

Believe me, I know what these people can do. A very dear and close friend of mine for many years was the only victim of the Iran–Contra fiasco. Oliver North pleaded and stated his innocence; he was approached by very important people of this government to simply plead guilty. He could not do this. His ethics and background would never permit it. Well, from a "time served" scenario it evolved to a 20-year sentence. There are so many stories that it is shameful to consider that this country's forefathers could look down and see the monstrosity that has come of their sacrifice and efforts.

If you like I will gladly stay in touch — many things are changing here in the Bureau of Prisons. All of the "privileges" have been taken away from us. Some people think that this is the military, mostly staff. But nonetheless, I see only chaos from all of this overregulation and a growing prison population. Look at the statistics and you'll see that we are now the leading country in the world for incarcerating people. Just as a note, California has more people incarcerated than all of Europe! This is absolutely ludicrous.

I wish you well.

John R.L. Walker ZL3IB. Sir, regarding the "Meter Made" article (*73 Amateur Radio Today,* March 2003) … I read N2DCH's article about recycling discarded VU and similar meters with interest, having done this myself for home-brew dip oscillators and similar projects. However, I should like to sound a note of caution and advise your readers that many cheap VU meters do not have linear meter movements. I found this out the hard way when trying to use one as an extended range voltmeter; the scale reading was not linear between 80% and 100% FSD!

On checking other similar meters in my junk box, I found that nearly all of them suffered from this problem. After further research, I found that this was a deliberate design feature to prevent overloading and was brought about by the use of non-uniform magnetic pole pieces. They are still useful as indicators for many projects but be warned: Check their linearity if you want to measure voltage or current accurately. (ZL3IB is the editor of *Break-In,* the Official Journal of the NZ Assoc. Radio Transmitters in Christchurch, New Zealand.)

Richard Appleyard. Hello, Wayne. Here is an update on my daughter. I am writing to inform you that with the help of three hams and the Hammond Museum, she won at the regional level of a Heritage fair competition, and is headed to the National Heritage fair competition in Sudbury, Ontario. Her project is about Reginald Fessenden, and part of her display is a one-tube regenerative radio receiver. Other students came over while she was setting up the display, and comments like "cool," "neat," and "nifty" were heard while they watched the tube glow and listened to two radio stations on the headphones. The judges were quite impressed also with the radio and her research and knowledge of Mr. Fessenden. Tom Domalkas provided research material. Rick VE3BK assisted in fixing up father's mistakes, and Don VE3OCY, pulled hairs and remembered his younger days while doing modifications and repairs to get it to receive. The Hammond Museum provided the information to construct the radio. The next project for Katherine is to obtain her amateur license when she can find time in between choir, keyboard lessons, and sailing lessons. So, Wayne, young people do have an interest when shown something — especially outside the Internet. She enters grade nine in the fall. Will need a computer to keep track of her skeds. 73

NEVER SAY DIE

continued from page 5

water. For some reason I believe it is still against the law to hang California legislators. Both laws should be repealed as soon as possible.

I won't retread all the evidence I've published about this monumental scam. Fluoride in the water does not and never has helped teeth. It mottles them. What it does is make people more docile. As I mentioned last year, both the Germans and the Russians used it in their concentration camps to keep prisoners docile and apathetic. It's against the law in all European countries but Ireland, where those famous Irish tempers have to be kept under control.

By the way, tooth decay is one of the first indications of a lousy diet. My mother fed me a healthy diet as a child, so I had absolutely perfect teeth until I'd been in the Navy for four years, when I had my first filling. As a child I ate no sugar, soda pop, white bread, cold cereal, jam, jelly, little ice cream, and so on.

California children have twice as much dental disease as children in other states … probably because of all that fluoride.

Oh, and fluorides also are tied to Alzheimer's. One extra benefit.

The Oil Curse

How come countries such as Saudi Arabia, Venezuela, Iraq, Iran, and other oil-rich countries are so amazingly backward? If you think about it, have you ever seen any product that's been manufactured in any of these countries in our stores?

What's happened is that the natural resource wealth is being controlled by a small group in each country and not used to educate their people, or invested in businesses. It's easier for those in control to enjoy the billions and use their power to keep the country closed off from the rest of the world.

As we've seen here in America, prices rise to meet the amount of money available to buy them. An American two-worker family today is making about the same in inflation-adjusted dollars as a one-worker family did sixty years ago.

Thus, in oil-rich countries prices are so high that factory labor costs too much to be competitive on the world market. So, few factories are built. Without industrial competition there is little technological innovation, so life for most people in those countries is grim. No wonder they are so jealous of us relatively rich Americans.

Wealthy Saudis prefer to invest in things like Harrod's department store in London rather than a business in Riyadh.

Oil is a curse for most of the people living in these countries, not a blessing.

Something Fishy?

The Navy has been training some new recruits to look for enemy divers to protect their ships against underwater attacks. Sea lions are being trained to find divers, attach a clamp to a leg and release a floating marker. They're also training dolphins to spot underwater mines and divers planting explosives.

Micro Solar Cells

Spherical Solar of Cambridge, Ontario, is making solar cells of tiny silicon beads of silicon sandwiched between aluminum foil, and sealed on both ends with plastic. The result is a denim-like fabric that can be draped over almost any shape to generate electricity. The claim is that this will obsolete solar panels.

Will their jackets be powering our kids' DVD players in a few years?

Any developments that help bring down solar energy costs are welcome.

El Cheapo Solar

Hey, keep those clippings coming. You know what I'm interested in … almost everything.

Anyway, a reader sent one about scientists at the Indian Institute of Science in Bangalore having developed a new kind of solar cell. It's a copper-indium-gallium-diselenide (CIGS) mix. It's flexible and can be produced in rolls, so the estimated cost is about 40% that of solar panels.

I'd like to be able to go off the power grid in case Planet X, though way behind schedule, arrives, but am too thrifty (okay, okay, cheap) to go solar at today's cell cost.

Reality Education

When I look back over my sixteen years of formal education, I'm hard put to remember the courses I've taken which have benefited me … in my business career, or in my personal life. Oh,

Continued on page 38

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Hugh Wells W6WTU
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Clamp-on DC Ammeter

A project suitable for ham radio? Of cores.

Measuring circuit current has always been part of the electronics side of ham radio, and ever since I was a little kid I've wanted to measure circuit current without having to open up a circuit to insert a meter. The project described here opens the door for ham experimenters to improve on and develop new and improved circuits for measuring current flow.

Clamp-on AC ammeters have been around for a long time and have really helped those who work on construction projects where AC is the primary source of power. However, not very many clamp-on DC ammeters have been made available for hams to use, although they do exist in the commercial world. I suspect there are several instrument design techniques available that allow a clamp-on technique to be used for measuring a direct current. Following my experiments with Hall-Effect sensors (*73 Magazine,* January 2003), the thought came to mind that the Hall sensor is a very simple approach for making a clamp-on DC ammeter a reality at a cost well within the reach of an experimenter. The issue isn't whether you need a clamp-on DC ammeter, but whether one can be built easily and inexpensively with available materials.

As a quick review of Hall-Effect sensors, keep in mind that the sensor is capable of detecting the presence of a magnetic field regardless of polarity. In fact, the sensor is sensitive to the polarity of the field in addition to the strength of the field, and comes in two basic types, switch and analog. Switch-type sensors are used in applications involving device travel limits, burglar alarms, and a wide variety of ON/OFF functions. The switch type would be a suitable choice for detecting the current flow, or loss of current flow, in many electrical/electronic applications.

Analog sensors may be used in a switch function but are designed primarily to sense the magnitude and polarity of a magnetic field that is present. The analog sensor is sensitive to a field that is moving (and rate of movement) with respect to the sensor's location. The output voltage response of the Hall-Effect sensor is linear between the plus and minus voltage rails, making it a great candidate for

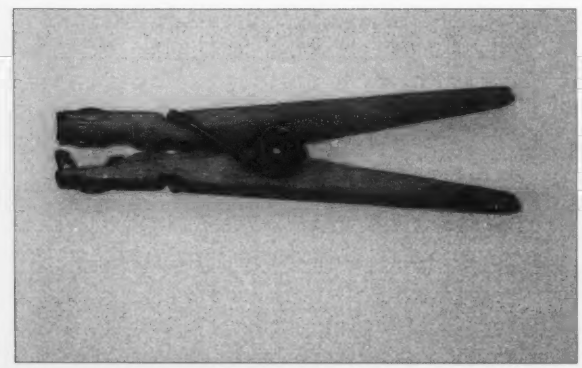


Photo A. *A side view of the wooden clothespin and a mounted core.*

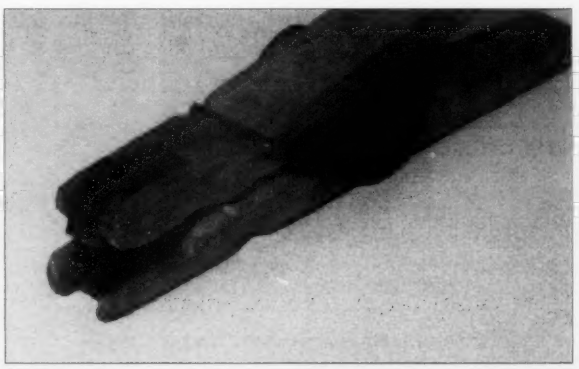


Photo B. *Oblique view of a core mounted in a wooden clothespin.*

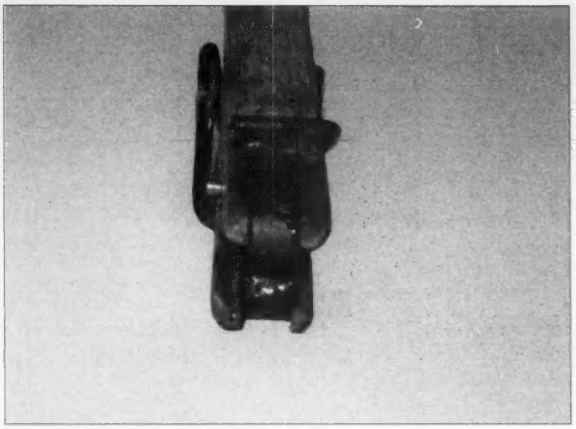


Photo C. *A head-on view of the mounted core.*

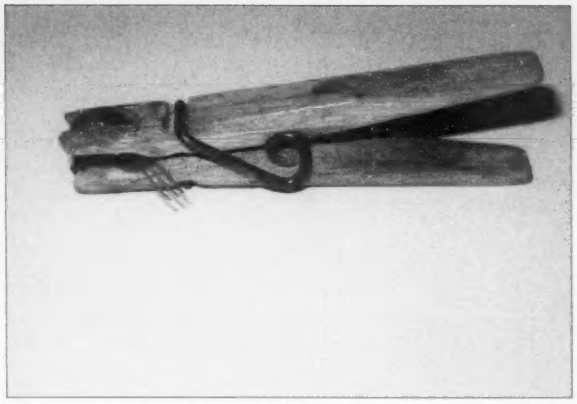


Photo D. *View of the Hall-Effect sensor after it was cemented to one core face.*

measurement applications. They also work well as a compass.

The output from a Hall-Effect sensor varies in two ways, and both must be understood when utilizing the sensor in a calibrated system such as an ammeter. The detected output response of the sensor will be logarithmic to a change in magnetic spacing between the magnetic source and the sensor. When the spacing is held constant, the output response will be linear to a magnitude change of the magnetic field.

The analog feature of the Hall-Effect sensor makes it a very good choice for use in a clamp-on DC ammeter application because it will sense the magnitude of the field produced by a current flowing through a wire. A magnetic field develops around a wire that is conducting a current, and the magnitude of the magnetic field is a direct function of the amplitude of the current flowing.

One of the previous difficulties experienced with the use of an analog Hall-Effect sensor was the issue of sensor drift/stability of the output as a function of device temperature. Fortunately, Allegro Microsystems, Inc., has developed a Hall-Effect sensor that is internally stabilized, and for this DC ammeter project the Allegro A3515 device was selected. As a result, the device's output signal information is as stable as the magnetic field being measured. To retain circuit stability, voltage regulation is a definite requirement for any circuit design utilizing an analog Hall-Effect sensor.

Cores and clamp

A toroid core may be utilized in several ways, but for an ammeter application, there are two simple techniques available. The first technique utilizes a wire wound several times around the core to multiply the effect of the magnetic field. Sensitivity to the current level is then a function of the number of turns of wire around the core to gain a desired magnetic amplitude response from the sensor. The second technique involves passing a single wire through the hole in the core and sensing the magnetic field produced around the wire as a function of current flowing along the wire. Obviously, the second technique produces the lowest sensitivity to current flow, but it is more adaptable to the clamp-on DC ammeter application.

Perhaps the most important part of the clamp-on DC ammeter project is the use of a magnetic core (toroid) to concentrate the magnetic field generated around a wire carrying a DC current. The magnetic field produced around the wire will be perpendicular to the direction of the current flow and will be concentrated by the core. Once concentrated, the magnetic field is allowed to pass through the Hall-Effect sensor that is placed in a gap cut in the core.

As an alternative scenario, consider the use of the Hall-Effect sensor without the presence of a core. If a wire conducting a current is placed close to the face of a Hall-Effect sensor, the sensor will detect the magnetic field, but the field level may be way too low/small for the sensor to respond sufficiently for our application unless we use a very high-gain amplifier. In addition, the physical location of the wire in relation to the sensor would create a logarithmic response if the wire is allowed to shift position. By utilizing a magnetic core, we can gather and concentrate the magnetic field into a small area and reduce the magnetic field loss that would occur in the absence of a core. Likewise, the wire may be

Continued on page 12

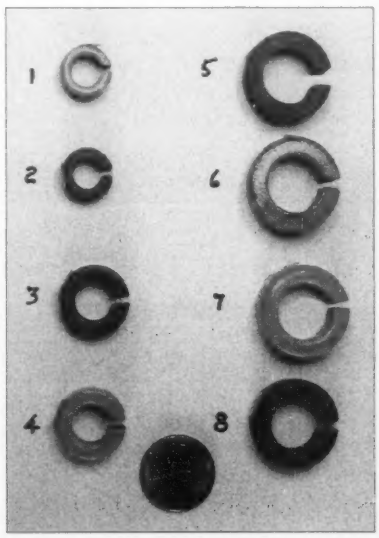


Photo E. *Shown are eight randomly selected cores that were evaluated for use in the clamp-on DC ammeter project. A penny is shown for size comparison.*

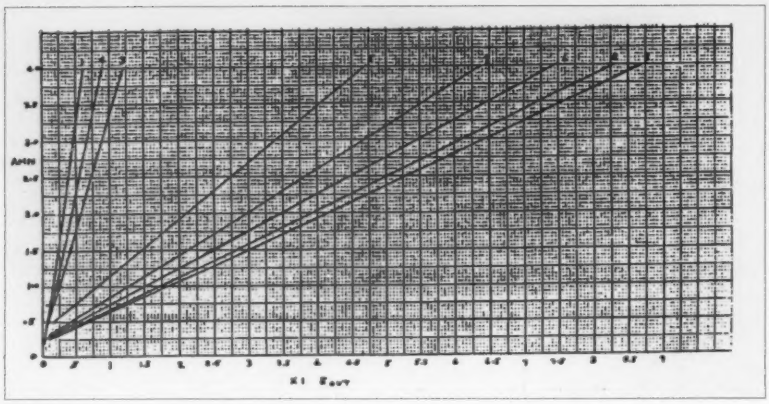


Fig. 1. Each of the available cores was evaluated for response with the results shown. Slopes to the left indicate the lowest response and the highest (greatest) response to the right. From left to right, core numbers are 1, 4, 3, 5, 7, 6, 2, and 8.

Clamp-on DC Ammeter

continued from page 11

anywhere within the core's opening for the sensor to respond linearly.

For the clamp-on ammeter project, a core was cut into two halves and mounted into a wooden clothespin for convenience as shown in **Photo A.** Cutting the core allows it to open up for placing a wire into the open hole of the toroid. Although the gaps in the core tend to reduce the efficiency of the field transfer, it is still the desired approach for the application. Maintaining smooth core faces that mate well is perhaps the most important mechanical aspect of the assembly. **Photos B** and **C** show other views of the core and how it's mounted into the clothespin. **Photo D** shows the position of the Hall sensor after it was glued to one face of the core. Contact cement was used to hold both the core into the clothespin as well as gluing the sensor to one core face. Contact cement tends to remain pliable and acts somewhat like a shock absorber for the core. The core can move slightly under spring pressure, allowing the core faces to mate when the clip is closed.

Connecting wires are attached to the sensor wires and then are secured to the clothespin to reduce the stress on the sensor. Although the final assembly is a little crude and needs to be refined, it certainly works well.

With a wide variety of unknown cores available and not knowing exactly how each would work in the application, eight cores (shown in **Photo E**) were evaluated, with the test results plotted in the graph as shown in **Fig. 1**. The cores that were evaluated were originally selected by color of the core material in an attempt to sort out the differences between ferrite (gray) and powdered iron (black). Because of a DC application, it was assumed that the powdered iron core would be the most suitable.

Each core was cut with a 0.064-inch gap so that it would barely slip over the sensor body for evaluation. The evaluation was performed using the Hall sensor mounted onto the circuit board and allowed to overhang the edge of the board. Known current values ranging from 0.2–4A was passed through a single wire inserted through the core being evaluated. Each core produced slight differences in response sensitivity to a given current, but all did react as expected, as shown in **Fig. 1**. The basic core material of those made from "black" material exhibited the greatest response. Cores 1, 3, and 4 showed the least coupling sensitivity, with cores 2 and 8 showing the greatest. Core number 2 was physically small and was more adaptable for mounting in the clothespin; therefore, it was selected for use in the project.

Even though cores 1, 3, and 4 exhibited the lowest response sensitivity to the flow of current, they did appear to be suitable for a clamp-on application where higher currents would be measured. The response linearity of all the cores indicates that any of the cores

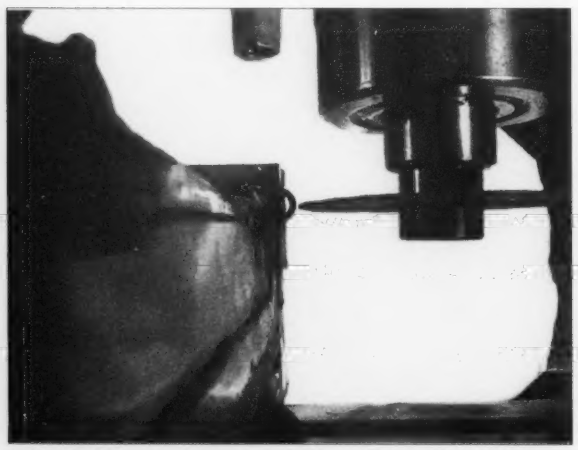


***Photo F.** View of a core being held by a mill vise prior to being cut by a cutoff disk.*

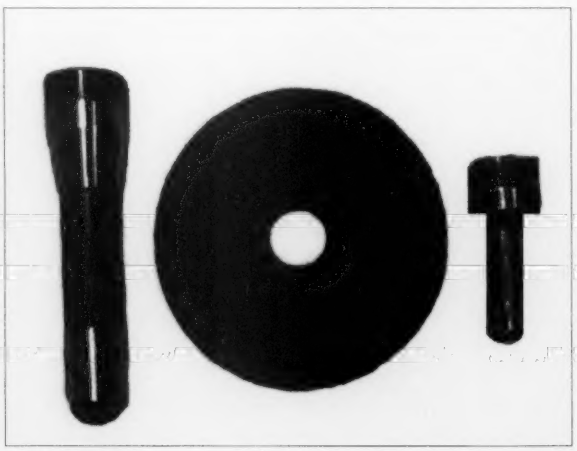


***Photo G.** Shown is a cutoff disk and two alternate, but suitable, mandrels.*

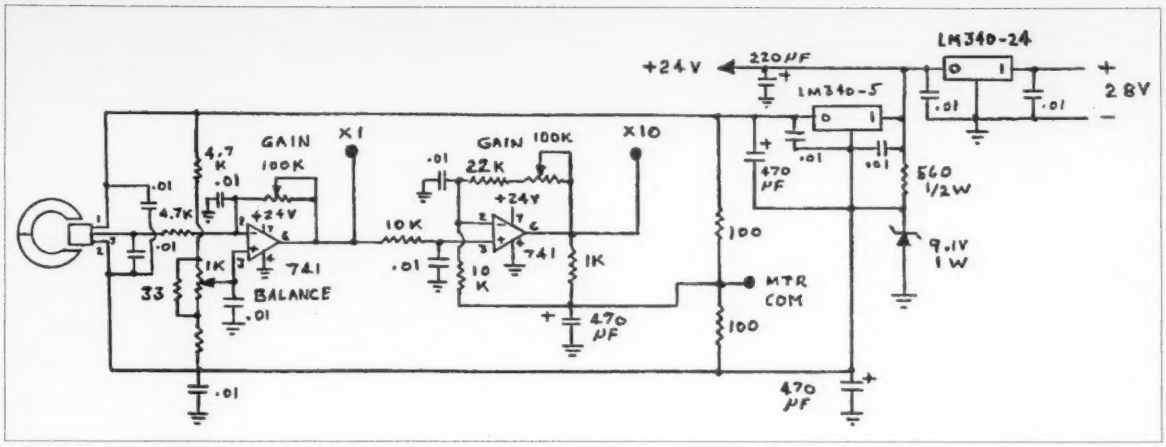


Fig. 2. Schematic diagram for the clamp-on DC ammeter evaluation. An analog Hall-Effect sensor is followed by two op amps to create both a "times 1" and a "times 10" measurement range.

evaluated would work well in the clamp-on application with an accommodation for circuit gain to achieve the ultimate objective.

Cutting the core

For this part of the project, I called upon Norm K6YPD to assist with the mechanical aspects. Norm was able to jig up the selected cores in a mill vise and cut each with a thin cutoff disk turning at a slow speed of about 200 RPM or less. Speeds of up to 2,500 RPM were tried with some success, but the lowest speed is recommended to reduce the risk of core damage. Operating the cutting disk at a high speed would cause a much higher instantaneous impact than when it is turning slowly.

Norm was very successful in cutting several cores in support of the project. The mill setup is shown in **Photo F**, although a drill press may also be utilized if proper jigging can be arranged.

Photo G shows the disk and two alternate mounting arbors that are usable with the disk. Norm suggests that a disk be selected having a thickness of 0.064-inch that has a reinforced fine grit structure. Although Norm used a 4-inch disk, the diameter of the disk is not critical.

Holding the core in the mill vise requires some care. Because ferrite and powdered iron cores are "hard" and "brittle," some shock mounting is needed, though the core must be held very firm to prevent movement. Norm was successful using double-backed masking tape and/or carpet tape as a means of holding the core with minimum pinch pressure. The double-backed tape reduces the tendency for the core to drift/move when cutting pressure is applied — be patient, as the cutting process takes time.

Of concern during the cutting process is that powered iron and ferrite cores can fracture both when clamped too tightly in the vise as well as when struck by the cutoff disk. As Norm indicated, the objective is to "rub" the core to wear away material in the area being cut.

After cutting the core into two parts, the total diameter of the split core is reduced by the amount of material removed. It is desirable to select a core that has a center hole larger than the maximum size wire anticipated to pass through the hole. Also, an additional 0.064-inch must be removed from one core face (or 0.032-inch from each sensor mating face) to accommodate the thickness of the Hall-Effect sensor. After cutting, the core halves should be placed together, with the Hall sensor inserted, to evaluate the mating core faces. If some face angle adjustment is required, a flat jeweler's pattern file will remove core material, allowing the core faces to become parallel when mated.

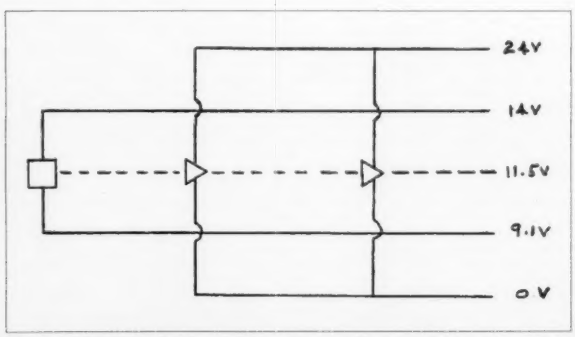
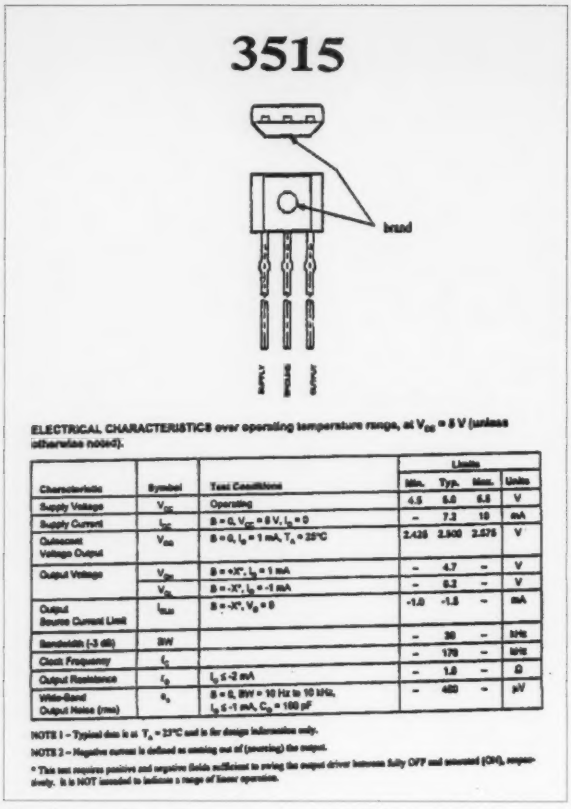


Fig. 3. Diagram shows the voltage distribution within the circuit.

Electronics

The electronics involved with the clamp-on DC ammeter is very simple and utilizes a two-stage DC amplifier, as shown in **Fig. 2**. The amplifier drives a digital voltmeter set on the 20 VDC range, yielding a direct current to voltage conversion. Two current ranges are established by cascading two operational amplifier ICs (op amps). Current ranging is established by controlling the gain of the amplifiers to provide a nearly direct current-to-voltage conversion. For this application, I chose to use a pair of LM741 op amps, but I suspect that a wide variety of available op amps, including the LM1458, would be suitable for this application. Obtaining an



ELECTRICAL CHARACTERISTICS over operating temperature range, at V_{CC} = 5 V (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			Units
			Min.	Typ.	Max.	
Supply Voltage	V_{CC}	Operating	4.5	5.0	5.5	V
Supply Current	I_{CC}	B = 0, V_{CC} = 5 V, I_O = 0	–	7.2	10	mA
Quiescent Voltage Output	V_{OQ}	B = 0, I_O = 1 mA, T_A = 25°C	2.425	2.500	2.575	V
Output Voltage	V_{OH}	B = +X*, I_O = 1 mA	–	4.7	–	V
	V_{OL}	B = -X*, I_O = -1 mA	–	0.3	–	V
Output Source Current Limit	I_{SOM}	B = -X*, V_O = 0	-1.0	-1.5	–	mA
Bandwidth (-3 dB)	BW		–	30	–	kHz
Clock Frequency	f_C		–	170	–	kHz
Output Resistance	r_O	I_O ≤ ±2 mA	–	1.0	–	Ω
Wide-Band Output Noise (rms)	e_N	B = 0, BW = 10 Hz to 10 kHz, I_O ≤ -1 mA, C_O = 100 pF	–	400	–	μV

NOTE 1 – Typical data is at T_A = 25°C and is for design information only.

NOTE 2 – Negative current is defined as coming out of (sourcing) the output.

* This test requires positive and negative fields sufficient to swing the output driver between fully OFF and saturated (ON), respectively. It is NOT intended to indicate a range of linear operation.

Fig. 4. *Spec sheet summary for the A3515xUA Hall-Effect sensor. Note carefully the pinout connections as related to the brand and package shape.*

initial stage gain of 50 or higher, low noise and DC stability are the critical factors involved. For my application, the LM741 was quite satisfactory though not the ultimate answer for stability and noise immunity. I did find that voltage regulation was a very important factor, and to gain it, I utilized two voltage regulators and a zener diode. Because the Hall-Effect sensor requires a very stable supply voltage operating between 4.5 V and 5.5 V, a 5 V regulator was used strictly for the sensor. The output of the sensor must reflect as accurately as possible the magnetic field developed around a current-carrying wire, and any supply voltage variation or noise voltage will shift the output indication.

One of the issues that I ran into with the project was in selecting the higher voltage regulator for the op amps that would provide a "split" voltage and still require only a single external voltage source. My criteria were met by using a 24 V regulator. Also, the external supply voltage has to be above 26 V for the desired regulation stability. **Fig. 3** shows the general voltage distribution that appears in the circuit. Though appearing complex, the voltage distribution and ultimate stability were the real criteria. A sufficient output voltage swing is required to enable a suitable current measurement range, and that required the split voltage supply for the op amps. With that in mind, an LM741 can swing to within about 2 V of the plus/minus voltage rails before the output flattens.

Some care must be taken to correctly identify the leads of the Hall-Effect sensor during installation. Because of the flat package, it is very easy to reverse the connections to the device. **Fig. 4** shows the device, its shape, and the leads for clear identification. The major keys to identification are the label marking, or brand, on the face of the device, and the package wedge shape. With the brand facing you and the leads pointing downward, the left pin is #1-Vcc, the center pin is #2-ground, and the output pin is #3, to the right.

A 2.5 V (approximately Vcc/2) output from the Hall-Effect sensor (in the absence of a magnetic field) establishes the "zero reference" operating level for the op amps, and a resistor divider between the 5 V rails establishes the "zero reference" for the second op amp and the digital voltmeter. Of course, the 2.5 V level from the sensor will shift some in the presence of any ferrous object. Placing a core around the Hall sensor will shift the zero point a small amount, requiring a rebalance of the amplifier. After circuit construction and the core is placed over the

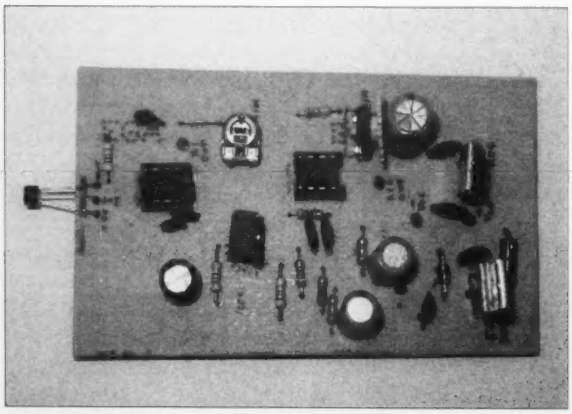


Photo H. *Top side view of the clamp-on DC ammeter's evaluation circuit board.*

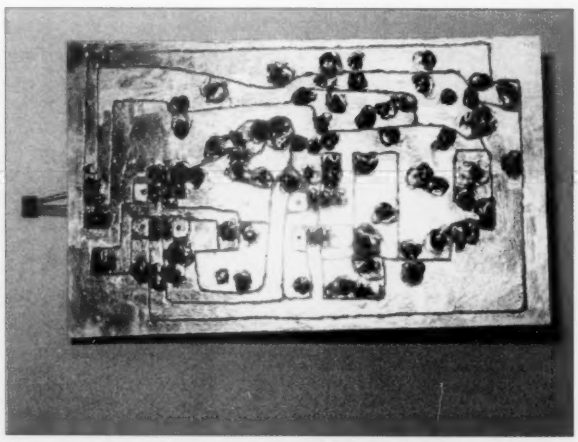


Photo I. *Bottom side view of the evaluation circuit board.*

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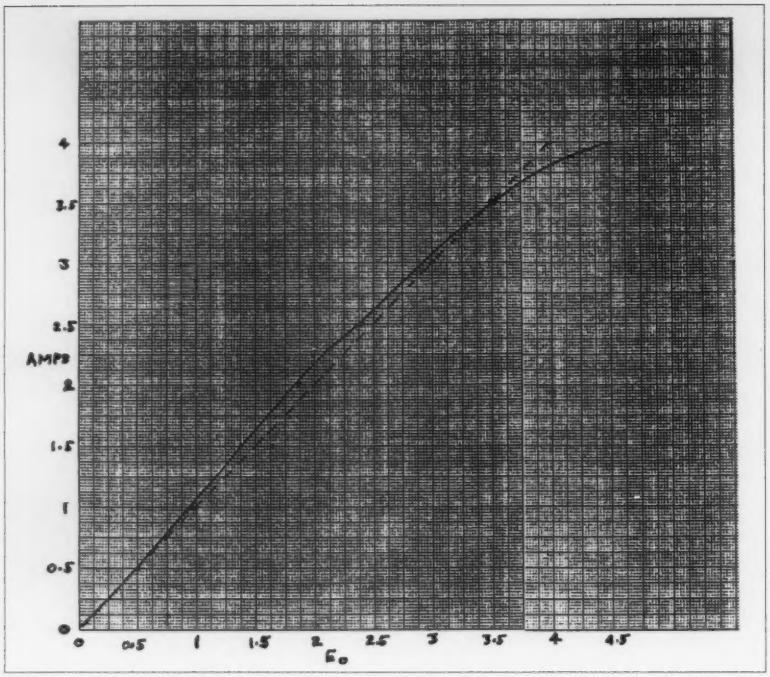

Fig. 5. X1 calibration response curve for measured current from 0–4 amps. The X1 gain was adjusted/calibrated at the 3.5 A value.

Hall sensor, the balance pot must bring the circuit to a balance. If the output from the sensor is a little too far above or below 2.5 V for the balance pot to correct, then a balance compensation may be required. Note that a 4.7k resistor is used on each side of the balance pot to assist in creating a vernier control over the balance adjustment by reducing the voltage across the pot. The center position of the balance pot may be restored by connecting a resistor in parallel with either the upper or lower 4.7k resistor. Select an appropriate resistor value that allows the balance pot to position itself near the center of rotation. Also note that a 33-ohm resistor is used in parallel with the balance pot. Again, the objective of the parallel resistor is to assist in making the balance pot a vernier adjustment by narrowing the voltage value across the pot. The values of the 4.7k resistors and the 33-ohm resistor may be shifted as desired to create a smooth vernier control over the balance adjustment range.

A negative aspect of this type of circuit design is that external ferrous objects such as screwdrivers, tools, metal fenders, etc., will upset the circuit balance. The circuit and measurement capability remains the same as long as the amplifier's balance can be achieved. As a plus factor, the sensor's linear output response is greater than the op amp's voltage rail limits. In other words, the op amp response will reach saturation and "flat-top" before the sensor has reached its swing limit.

When in operation, the core's mating surfaces vary some from measurement to measurement, causing a slight variation in the meter's ZERO setting. A slight adjustment of the balance control corrects that error. Except for accurate current measurements, an absolute circuit balance is noncritical.

Photo H shows the top and **Photo I** shows the bottom side of my test board that was cut/patterned with a dental burr. As shown, my preference is to leave as much copper on a test board as possible. There are times when a new trace section may be needed and the extra copper on the board can circumvent the use of a long jumper wire by cutting a new trace. Building the circuit on a circuit board is not necessary, but mechanical stability and short lead lengths are probably important since the amplifier operates at a fairly high gain level. Other than for mechanical stability and voltage regulation, there is little in the circuit that's critical.

Calibration/response

During my testing phase, the clamp-on DC ammeter was able to detect the presence and absence of a current as low as 10 mA, but the amplifier's lack of noise immunity tended to override the ability to "measure" such a low current value. However, measurement capability and reliability improved greatly as the current value increased.

Calibration of the project is accomplished in three steps. The first step is to set up a known current around 3–3.5A for the X1 range. The gain of the first amplifier is adjusted until the digital meter indicates the known current value. For the second step, the current is decreased to a value in the range of 150–200 mA (let's say 200 mA) and with the digital meter switched to the X10 output, the gain of the second stage is adjusted to obtain a reading of 0.2 V.

The third step is a verification step used to fine-tune the gain adjustments of both amplifiers by repeating the first two steps. Because of the interaction between directly coupled amplifiers, some minor adjustment changes are expected to occur during the first calibration pass.

Although the gain of the first stage is dictated by the core's response sensitivity, the basic stage design gain is between 10 and 50. It's possible to be higher and/or lower to meet the need. For the second stage, the gain is desirably set to a value of 10 in order to maintain the X1 and X10 multiplier relationship.

Figs. 5 and **6** show the calibration response curves that I obtained using core #2. Please note that the X1 calibration curve, although nearly tracking the absolute current "dotted" line, does swerve some, indicating an error in reporting the exact current that is being measured. Of most concern is the response deviation from the norm at current values below 3.5 A, assuming 3.5 A to be the upper measurement value. X1

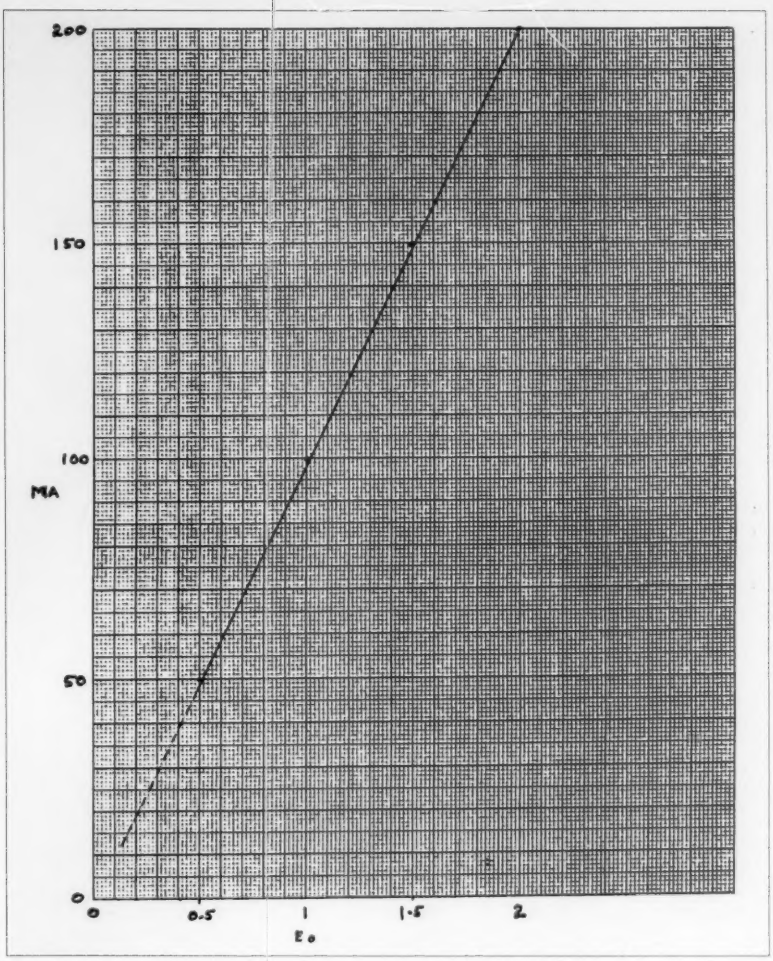

Fig. 6. X10 response curve for currents measured from 0–200 mA.

calibration for **Fig. 5** was done at exactly 3.5 A to achieve the tracking curve shown. If greater measurement accuracy is desired for current values below 3.5 A, then the X1 amplifier gain may be adjusted with a known current between 2 A and 2.5 A. Such an adjustment would provide a reasonably accurate indication up to the calibration current value. Above the calibration value, the accuracy will decrease with increased current values as indicated by the shape of the response curve. Although I didn't sort out the reason for the response curvature, I suspect that it is related to the LM741's response, since the Hall-Effect sensor is linear from rail to rail, and neither rail was reached during the test.

Linear calibration response is achieved in the X10 range up to 200 mA and is shown in **Fig. 6**. As long as the gain of the first amplifier is set to provide an accurate response for a current at 1 A or higher, the X10 range will provide a linear response.

Conclusions

After wanting a clamp-on DC ammeter for a long time, having one available has been a real treat for me. Although I didn't try switching my digital meter from the DC to the AC range, it's possible that the clamp-on project will work for both AC and DC applications. It has also been an interesting project requiring a lot of thought processing and investigation to make it a simple TO-DO type of electronic project. The only negative

Continued on page 57

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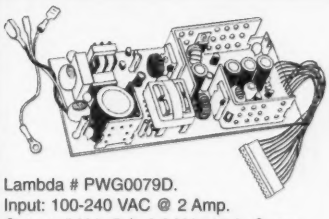

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The Ins and Outs of Parts Substitution

Part 1: Understanding the basics.

Since the beginning of the development and construction of electronic devices, components have been the key to a successful project. As time passes, parts for electronics are developed, modified, and then replaced with newly developed ones. Many of the older parts have been abandoned, leaving the ham experimenter of today with circuit designs and older equipment containing parts that are generally no longer available.

Regardless of the diminishing availability of "common" parts, hams are ingenious in the way they can substitute parts to make a desirable project work, regardless of when it was developed and what parts it was designed to use. Yes, as time moves forward, the availability of discrete electronic components appears to be decreasing. With many of us still building and experimenting with circuits developed and published in the past, we have to substitute for many of the parts, particularly semiconductors, in order to complete a chosen project.

Every ham has his own way of dealing with the parts substitution process based upon experience, knowledge of circuits, knowledgeable friends, network search engines, catalogs, substitution guides, and lastly perhaps giving up on the project. If you've read any of my past articles, you realize that I thoroughly enjoy working with electronic circuits, and that this effort has raised my sensitivity to the reduced sourcing of available parts for us to use in our projects. One of my many solutions was published in the April 2002 issue of *73 Amateur Radio Today*, describing my "ham junk box" and how I save parts from various sources to create a personal parts buffer.

True, having a huge junk box of parts solves a piece of the problem, but it doesn't help much in constructing a project with specified semiconductor parts that are no longer available. The solution then entails finding an available part that will work in the circuit. In the worst case, some circuit redesign may be required to accommodate the "new" part in order to make the circuit function. Although there is no simple answer to finding a substitute part, please follow along with the processes that I employ that help me hurdle the substitution barriers.

For a successful substitution process, you must be dedicated to finding a suitable part — and that generally means WORK! Here is a generalized listing that, if followed, will turn up a suitable part for most any circuit (although substituting a semiconductor for a vacuum tube, though possible, is reaching a bit far for this discussion).

1) Search for the exact part by number.

2) Utilize component catalogs to determine available parts.

3) Contact dealers handling obsolete semiconductors.

4) Use a network search engine to find a substitute.

5) Utilize network searches to determine part specifications, and/or to characterize the part's parameters.

6) Utilize available part substitution manuals to find a similar part.

7) Use the Internet chat forums for part search/substitution information.

8) Examine the circuit to determine device function and requirements.

9) Identify available parts and overlay their specifications to the application.

10) Identify circuit differences — determine what, if any, circuit modifications are required.

11) Select a suitable/available replacement part.

Part search

Obtaining the desired part by indicated part number is always the first choice for a project builder. But when the part is not available locally, you have to widen the search area. Searching for a specific part requires that you have access to potential sources that handle the desired part. Finding an outlet is perhaps the most difficult part of the search unless you have saved a catalog or are on the distribution list

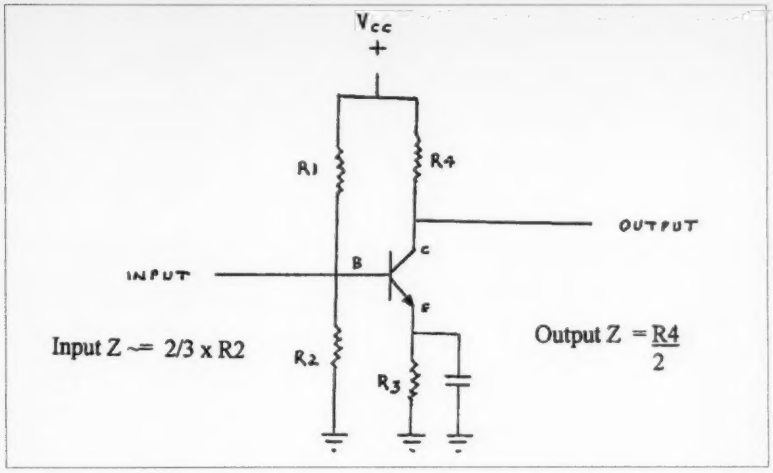

Fig. 1. Shown is a basic low frequency amplifier stage using an NPN junction transistor. All common emitter circuits are biased essentially as shown.

for supplier catalogs either in hard copy or on-line. Some of the more common catalog and reference suppliers that come to mind are All Electronics, Digi-Key, Mouser, Jameco, Newark, and Radio Shack.

When parts become obsolete, reference catalogs and data information generally get trashed. One of the solutions is to retain old reference material because it can provide the basic parameter information you require for making substitution decisions. The most complete and most accurate device specification data is published by D.A.T.A. Reference Standards. Copies of the older and obsolete D.A.T.A. books are found at swapmeets.

An aspect of what's happening today is that few outlets are available for single lot purchases. Of those organizations and distributors that do stock parts that we need, many have established a minimum order quantity that inhibits single part purchases. A group purchase helps resolve the problem sometimes, but in most cases we need only one or two parts to complete a project. Fortunately, the NTE line of parts is widely distributed and is readily available as a parts source for the ham community. An NTE on-line substitution/specification service is extremely helpful.

Some parts and specifications can be located by using the on-line search engines. Suppliers using the Web for their e-catalog listings are usually smaller businesses that may buy in large quantities for distribution to the ham market, or they buy surplus and end-of-the-run items from larger companies. As a result of their purchasing technique, their inventory changes over time. This means that if the desired part was in inventory yesterday, it may be gone tomorrow. However, from my experience, these suppliers offer new parts at reasonable prices and need to be queried before moving on to the next level of search.

Word of mouth has always been a good way of finding that elusive part. With the number of hams who operate E-mail and participate in technical discussions, you have only to present the part number and someone will have a suggestion as to where it or a suitable substitute is available. Two

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Part #	Type	Power	Ic	Vce	hfe	Freq	Case
2N918	NPN	200 mW	50 mA	15 V	20	600 MHz	TO-72
2N2102	NPN	1 W	1 A	65 V	40	60 MHz	TO-5
2N2222	NPN	500 mW	800 mA	50 V	60	250 MHz	TO-18
2N3902	NPN	1.3 W	2.5 A	400 V	60	40 kHz	TO-3
2N3904	NPN	310 mW	200 mA	40 V	100	300 MHz	TO-72
TIP 29	NPN	2 W	1 A	40 V	100	3 kHz	TO-220
2N2907	PNP	400 mW	600 mA	40 V	100	200 MHz	TO-18
2N3171	PNP	75 W	3 A	40 V	30	1 MHz	TO-3
2N4404	PNP	5 W	500 mA	80 V	100	200 MHz	TO-39
2N3906	PNP	310 mW	200 mA	40 V	100	250 MHz	TO-92
MJE2955	PNP	90 W	10 A	60 V	50	2 MHz	TO-127
TIP 32	PNP	2 W	3 A	60 V	60	3 kHz	TO-220
Part #	**Type**	**Power**	**Id**	**Vds**	**mhos**	**Freq**	**Case**
2N3819	Nchan	360 mW	10 mA	25 V	4000	400 MHz	TO-92
2N4416	Nchan	300 mW	10 mA	30 V	5000	400 MHz	TO-72
2N5245	Nchan	360 mW	30 mA	30 V	6000	400 MHz	TO-92
2N5545	Dual Nchan	250 mW	30 mA	50 V	4000	2 MHz	TO-71
MPF 102	Nchan	200 mW	10 mA	15 V	3000	200 MHz	TO-92
TIS 34	Nchan	360 mW	4 mA	5 V	2000	450 MHz	TO-92
3N128	Nchan	330 mW	25 mA	20 V	5000	300 MHz	TO-72
40601	Nchan	400 mW	18 mA	20 V	10k	450 MHz	TO-72
2N5797	Pchan	200 mW	10 mA	15 V	100k		TO-92
3N158	Pchan	300 mW	5 mA	15 V	2000		TO-72
3N162	Pchan	2 W	250 mA	30 V		45 MHz	TO-33
U110	Pchan	300 mW	1 mA	10 V	500		TO-18

Table 1. *This is a table of randomly selected active elements. The characteristics shown are the basis from which a replacement/substitute part is selected.*

such discussion forums are the QRP group, and the HF Pack. The hams that participate in the forums are very knowledgeable and extremely helpful (see references at the end of part 2).

There are several suppliers that handle obsolete semiconductor parts and will sell them in individual quantities to hams. These suppliers obtain their inventory from companies that clear out their parts inventory at the end of a production run in addition to obtaining the end-of-the-run residuals from the semiconductor manufacturers. When a part has been deemed obsolete for new production, it is held in company inventory for only a short period before it is either scrapped or sold off as surplus. Having dealers available that are willing to pick up the surplus inventory is a real boon to hams, because that action retains a quantity of desired parts for an extended period of time. These surplus dealers are most easily found through Internet searches.

Part substitution

When the search effort has left us without a desired part, the next step is to find a suitable substitute. Finding a substitute part that will work in a particular circuit location doesn't necessarily mean that the desired part and the substitute are the "same" part with only a different identification. Though it's possible that the two parts were made from the same mask design, it would be a rare occurrence when the substitute part exhibits an exact electrical match. But in reality, it's the similar functional characteristics that count.

So, how do you find a suitable substitute part? Fortunately for hams, several manufacturers providing a line of substitute parts for the TV/VCR repair business make them available through local distributors. Formerly ECG and now NTE is the foremost supplier.

In support of the substitution process, conversion books have been published both in hard copy and online, providing a very extensive listing of substitute parts that will accommodate a multitude of commercial part numbers. Specification and data information for many parts may be obtained by doing catalog searches from information provided by, D.A.T.A. Reference Standards, Digi-Key, Motorola, Mouser, National, Radio Shack, and Texas Instruments are examples. Even though some of the substitution manuals and catalogs are obsolete and out of print, having them available assists in obtaining relative specification information including pinout information on the older parts. I happen to have an Allied Radio catalog, printed perhaps in the 1950s era, that I have called upon for data on early transistors.

Substitution process

One of the problems that a ham will encounter with some substitute parts will be the pinout of the substitute part as related to the "desired" part. You have to be careful to evaluate both the mechanical and electrical part differences before installing the substitute part. In the case of a TO-92 transistor, the "old" and the "new" parts may "look" the same, but the pinout of the "new" part may be oriented as EBC, ECB, BCE and/or the less common BEC. Assuming that the electrical parameters are similar, then only the lead orientation needs to be accommodated for the substitution to take place.

In general, common junction transistors (also referred to as bipolar transistors) used at frequencies below 200 MHz are fairly easy to substitute because the electrical characteristics are sufficiently close, or similar, allowing normal operation within the design of a "typical" circuit. The major differences are related to the polarity of the

Part #	Type	Power	Ic/Ids	V	hfe/mhos	Freq	Case
2N222	NPN	500 mW	800 mA	50 V	60	250 MHz	TO-18
2N3904	NPN	310 mW	200 mA	40 V	100	300 MHz	TO-92
Compare to:							
NTE 123AP	NPN	625 mW	600 mA	40 V	200	300 MHz	TO-92
2N3906	PNP	310 mW	200 mA	40 V	100	300 MHz	TO-92
Compare to:							
NTE 159	PNP	625 mW	1 A	80 V	180	200 MHz	TO-92
2N3819	Nchan	360 mW	10 mA	25 V	4000	400 MHz	TO-92
2N4416	Nchan	300 mW	10 mA	30 V	5000	400 MHz	TO-92
2N5245	Nchan	360 mW	30 mA	30 V	6000	400 MHz	TO-92
40601	Nchan	400 mW	18 mA	20 V	10k	450 MHz	TO-72
Compare to:							
NTE 312	Nchan	360 mW	15 mA	30 V	5500	400 MHz	TO-92
NTE 451	Nchan	310 mW	10 mA	25 V	4000	400 MHz	TO-92

Table 2. *This table shows comparative data for selected parts that can be used to substitute for one another. Using this comparative process, a suitable replacement/substitute device can be selected.*

device, e.g., NPN and PNP, and the base material of germanium or silicon. Substituting an NPN for a PNP, or vice versa, is not normally done, though possible by changing the circuit polarity. But with the number of available devices for substitution, switching device polarity is not needed.

We've reached the point in the substitution process where we must evaluate the device used in "our" circuit so that we can choose an available transistor for the one indicated in the schematic. Let's spend a few moments and look at a circuit and evaluate how we can substitute one transistor for another. The first step is to focus our attention on only the device in question that's shown in the schematic.

Most transistors are used in a "stage" that is electrically isolated from other stages by using coupling devices. When a transistor is used in an isolated stage, the voltage applied, the resistors used, and the resulting bias all apply to only that single transistor. When the function of the "stage" is understood, then substituting another transistor means that any transistor will function in the circuit as long as the circuit's functional parameters are satisfied.

Some schematics are pretty complex, as drawn, and it's difficult by eye to isolate the stage using the transistor that needs to be replaced. If and when the "whole" of the schematic tends to create confusion, then you need to block out all of the schematic except for the subject transistor and its supporting components. One technique that I use is to bring my hands together, palms down on the schematic, and move them together until the area between the two thumbs and forefingers creates a near circle. Adjust the diameter of the circle until only the transistor and its associated resistors and capacitors are exposed. The circuit that's now shown in the viewing circle is all that we need to consider during the first step of substitution.

The second step is to look at the resistors around the device to gain an understanding of how the transistor is expected to operate in the circuit. The substitution question is, "What other device will work in that exact circuit?" For a circuit using a junction transistor, most any similar device will operate within the DC parameters — and that's 90% of the battle. "DC" refers to direct current, but when used in the context of this discussion, it refers mostly to the low frequency characteristics of a device that can be determined using direct current testing techniques. Then, based upon what you know about the transistor that's called for in the

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schematic, you can do a specification overlay of characteristics with transistors that are available and then choose one to try.

Fig. 1 shows a simple NPN transistor amplifier with the supporting resistor network needed for the transistor to be biased for linear signal operation (Class A operation). When reviewing a circuit as that shown in **Fig. 1**, the input and output impedances may or may not be a factor in the substitution process. An estimate of the input impedance is close to the resulting value of R1 and R2 being in parallel, or about 2/3 the value of R1. The output impedance is close to 1/2 the value of R4.

Only the supply voltage polarity would be different if the circuit called for a PNP transistor. When substituting or selecting a transistor for the circuit, the parameters of frequency response, gain (both AC and DC), and Vcc are the most critical. For most transistors currently available for substitution, the maximum collector voltage value they can handle will normally exceed the Vcc called for in the circuit, removing Vcc as an issue. That leaves frequency response and stage gain as the only significant factors for device selection. Specification gain figures are noted as hfe (AC gain) and HFE (DC gain). DC gain is also noted as beta (ß) in some specification sheets.

Many of the older schematics called for the use of 2N2222 and 2N2907 transistors. Both are silicon devices and may be substituted easily with currently available silicon transistors since the specifications will overlay as a near match. The 2N2222 and 2N2907 transistors were packaged in TO-18 cans and the newer devices available are packaged in plastic with the most common being the TO-92 package. The 2N39XX series of transistors are plastic substitutes for most NPN and PNP applications. An NTE 123AP is a suitable NPN substitute. Therefore, you need only to match the NPN-to-NPN and PNP-to-PNP for the circuit to function nearly as designed. For other old transistor devices, NTE substitution references would be a clear choice.

Some older RF circuit applications call for a 2N918 transistor because it would "sing" up to 800 MHz. Availability of the 2N918 (2N3600) is now limited, but better transistors are now available as replacements and they are the NTE 69 and the MRF 901 (NTE 64). The mounting configuration differs for each, but the electrical parameters will overlay sufficiently for the available devices to perform in many early circuit designs.

Parameter comparison

To demonstrate how to proceed with a device substitution, I've pulled some device part numbers from various old schematics in my file and have listed them in **Table 1**. If I desired to construct a project of interest using an old schematic, I would have to locate the indicated part or find a substitute that is currently available. If not available, I would then be faced with finding a suitable substitute that will work in the circuit. For most circuit applications the indicated characteristics like those shown in **Table 1** are all that need to be considered when selecting a replacement device. However, as a caution, when the device is used in a receiver or converter's front end, the device's noise figure must also be included in the evaluation. The lower the NF number in dB, the better.

To bring the parameter overlay process into focus, I've prepared **Table 2** to show a "parallel" listing of typical device characteristics for both transistors and FETs. For this chart, I've pulled data from **Table 1**. We'll assume that our schematic calls for these parts and our search has failed to turn up the indicated part. One of our options is to use the NTE series of parts to find our replacement, and to do that, I've selected some NTE parts for comparison. At best, the chart can only show a comparison of the "DC" characteristics with a reference to the highest frequency the device will operate. Beyond the "DC" characteristics, other parameters include noise figure, input and output capacitance, and case/package style. After reviewing the specific device parameters, decide which are the most critical for use in the project circuit, and in the examples shown, in all likelihood the replacement part will successfully substitute for the part shown in the schematic. Some manipulation of the package leads may be required to achieve the proper connections.

Perhaps the greatest substitution difficulty will be encountered when the transistor shown in the original schematic is a germanium device. Although the circuit is simple and might appear as shown in **Fig. 1**, the device specifications will be lower than what most modern silicon transistors exhibit. As a result, should a silicon transistor be used to replace the original device, the circuit may perform differently than was intended. However, if the circuit is operating below 500 kHz, the substitution process will tend to be more successful than when dealing with an RF environment. Doing an analysis of the original circuit and overlaying a new circuit, such as that shown in **Fig. 1**, may provide enough clues to install a silicon transistor and obtain near-equivalent performance results. Of concern when using a silicon transistor is the base bias value that will be at about 1.7 V (0.7 V above the emitter) above ground for linear operation.

Where the real rub comes in during a silicon substitution for a germanium device will be in the presence of RF. Although the circuit of **Fig. 1** may apply, the RF circuit parameters will differ greatly between germanium and silicon. Germanium transistors generally operated at lower signal swing amplitudes, with a DC level of typically 0.3–0.5V between the base and emitter, while a silicon transistor will require a signal swing above a DC level at 0.7 V. Likewise, the collector voltage of a germanium device is very low when compared to a modern silicon transistor. If the circuit design shows a Vcc of, say, 4.5 V because the transistor may have a max collector voltage rating of 6–9 V, then installing a silicon transistor may create the issue of insufficient Vcc for the silicon device to function properly in the original

Continued on page 57

Don Grayson W9QKC

How to Check Transistors with an Ohmmeter

Or: Let's cheat.

What the ham needs is a good go-no-go way of checking transistors with a piece of gear that he already has. Most transistor testers give you all sorts of exotic numbers and are expensive. What we want is a method to cheat and get a good idea of the quality of the transistor for the least fuss and cost.

First, let's examine the transistor to see what is available to measure. **Fig. 1** shows the equivalent configuration of a PNP transistor. You will note that it is shown as two diodes, the emitter, and collector with a common cathode, the base. This is actually how the transistor is made. It operates by injecting a little current into the base which controls the number of electrons that flow from the collector to emitter. This, basically, is all there is to transistor action.

At first glance it would appear that, since the transistor is just really two diodes, we could just take an ohmmeter and measure the forward and backward resistances of the two diodes. We would set it up as in **Fig. 2**, and if the transistor were good we could expect results like those shown. This test will give us some information about the operation of the emitter-base and collector-base diodes but leaves us in the dark about whether it has even any gain or not. In other words, it does not test the basic operation of the transistor. In fact the transistor can have a collector to emitter short and still have good diode action on both the emitter and collector.

Well, you say, "Why not measure between the emitter and collector, that will surely detect a short." Sure it will, but define a short. Remember that now we are not measuring the ratio of forward to backward resistance, but the backward leakage resistance of one diode in series with the forward resistance of another diode. What will be a good number for one transistor will be a dead short for another. There would be a tremendous variation in this resistance from a small signal silicon RF amplifier to a germanium audio power amplifier. And we still know nothing about whether the thing will amplify or not. Besides, the manufacturer does not normally give such data anyway. What we want is a foolproof method of deciding if the thing is "transistoring" even though it was invented in Russia in 1933.

Well then, let's set the thing up in a circuit like it is supposed to work and squirt some current into the base to see if the current going through the collector-emitter leads does increase. If we are careful about polarity we can use our trusty ohmmeter to do this. An ohmmeter is nothing but a battery in series with a resistance and a meter. Assuming that we want to test an NPN transistor, we merely place the positive test lead on the collector and the negative lead on the emitter. A small amount of leakage current will flow which will be indicated as a resistance

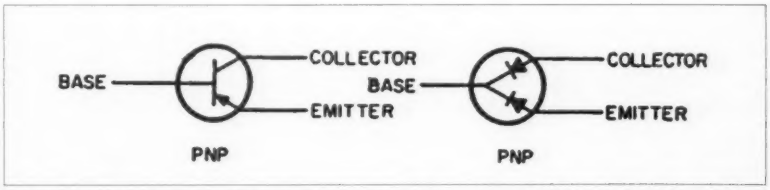
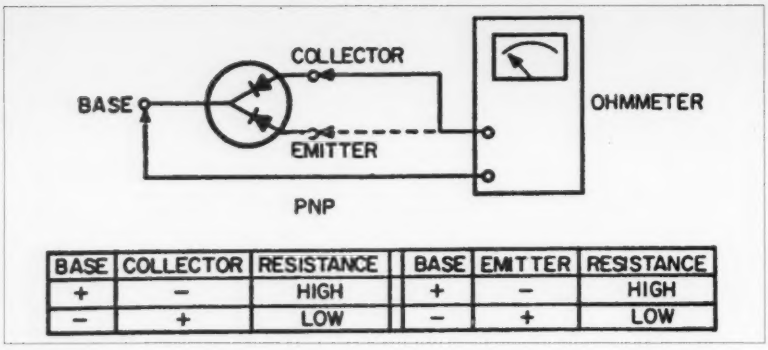


Fig. 1. *At the left is the symbol of a standard PNP transistor. At the right is the equivalent physical configuration of this transistor. Note that it is actually two diodes tied to a common point, the base.*

By popular request, reprinted from the March 1962 issue of *73 Amateur Radio*. What types of articles would *you* like to see from the golden days of yesteryear?



BASE	COLLECTOR	RESISTANCE	BASE	EMITTER	RESISTANCE
+	−	HIGH	+	−	HIGH
−	+	LOW	−	+	LOW

Fig. 2.

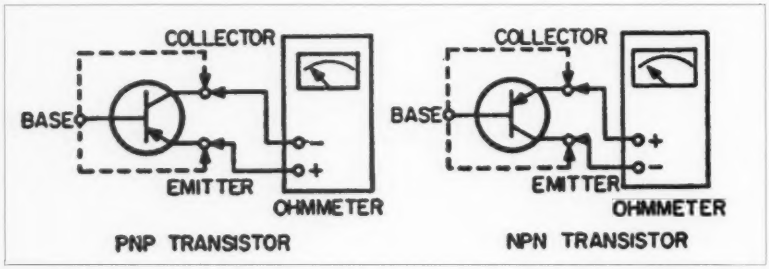


***Fig. 3.** With ohmmeter in R x 100 scale (assuming that the meter uses a 1-1/2 volt battery), a good transistor will be indicated by a decrease in resistance when the base lead is touched to the collector and a small increase in resistance when the base lead is touched to the emitter.*

on the ohmmeter. The theory says that if we apply a positive voltage to the base the current in the collector-emitter circuit should increase.

Well, that's easy enough to do, just push the base lead over until it touches the positive collector lead. If the transistor has any gain, the collector-emitter current should increase. Of course, since we are using an ohmmeter our indication will be a decrease in resistance. As a further check, push the base lead over and touch the emitter lead. This effectively grounds the base and the current in the collector-emitter circuit should decrease from the value of current with the base left floating. This, of course, will be indicated as an increase in resistance on our ohmmeter.

Notice that all of these measurements are relative to each other — we don't have to have any data or "reference." Actually, in each configuration you are measuring a basic parameter of the transistor, and, if you happened to have the curves for that transistor, you could check them. In the first configuration with the base open the measured parameter is I_{ceo}, current through the collector-emitter with the base open. The second configuration with the base tied to the collector is actually a measurement of the transistor's beta. (The manufacturer usually calls this hfe.) The third configuration is a measurement of I_{ces}, current through the collector-emitter with the base shorted to ground.

It is a bit hard to obtain exact numbers on these parameters as we are looking at a linear representation of basically a logarithmic device. If the collector-emitter current does go up when we apply the proper bias to the base, we know that the device has a beta and it is "transistoring." This information is augmented by the action of the current when the base is grounded. On a DC basis, we can now select a "hot" transistor from several of a similar type by picking the one that shows the greatest resistance change.

Now that we have examined the basic idea, let us look at the details. **Fig. 3** shows the basic circuit using both NPN and PNP transistors. In each case, proper transistor action is indicated by the resistance going down when the base is connected to the collector and up when the base is connected to the emitter. Normally the resistance change when the base is connected to the collector will be several times greater than the resistance change when the base is connected to the emitter.

One important question that must be answered is which resistance scale should be used. This depends entirely upon the voltage used by the ohmmeter and the internal resistance of the ohmmeter. The midscale resistance reading on the ohmmeter dial is the internal resistance of the ohmmeter circuit on that range. The maximum current will therefore be the battery voltage divided by this resistance. On most ohmmeters, this is 1,500 ohms on the times one hundred scale. This coupled with the almost standard 1-1/2-volt battery means that no more than one milliampere of current can flow. Since even the lowest-powered transistors are almost always rated at one milliampere at least, this means that R X 100 is the logical scale on which to start. It will be impossible to injure most transistors with one milliampere no matter how it is connected.

On germanium transistors, especially

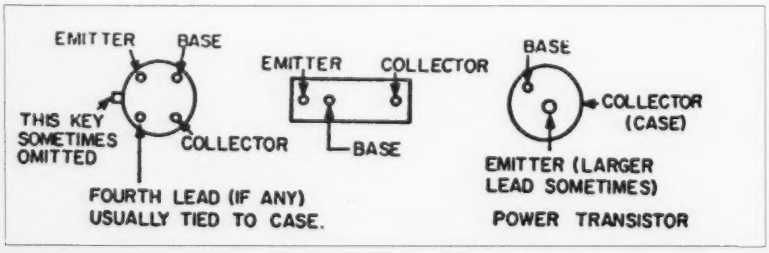


***Fig. 4.** Standard transistor lead configuration — all views of transistors from bottom.*

Continued on page 58

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Two Monitors Are Better Than One

Run tandem screens and really impress 'em.

What do you do with that old monitor when you upgrade to a larger one? That's easy to answer: Use it.

I decided to try this, so I installed the monitor card from an older computer into my Gateway 333c computer. It was a Trident 9645/96/80/9682/9385/9382/9385-1 pci. I installed it in a vacant slot on the motherboard. (Note: This older card limited my display definition to the ability of the old card, so I recommend using the same card as the original if you can get one.)

After hooking up the old monitor to it and restarting the new computer, a window came up telling me that if I could read it, it was installed. It gave me the choice of putting it to the left, right, or on the top, so I chose left. I clicked on an icon and moved it to the other screen. It worked so well that I moved *all* the icons.

I brought up my MixW program by clicking on that icon, and the program came up. I found that you have to be in the restore size to move it, but I did go to the blue area on the top and moved the running program to the other screen. It gives the ability to move anything to anyplace you wish it.

I like running the program when I am writing something like this in the main screen. If I want to, I can copy something from another program I

Continued on page 59

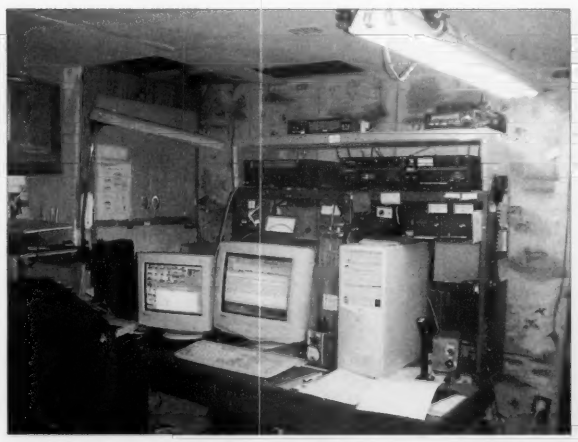

***Photo A.** A view of W6PNW's shack showing the two monitors at his operating station. MixW is in the monitor on the right, with parts of it in the monitor on the left, along with the word processor running in the left monitor while part of the desktop is showing.*

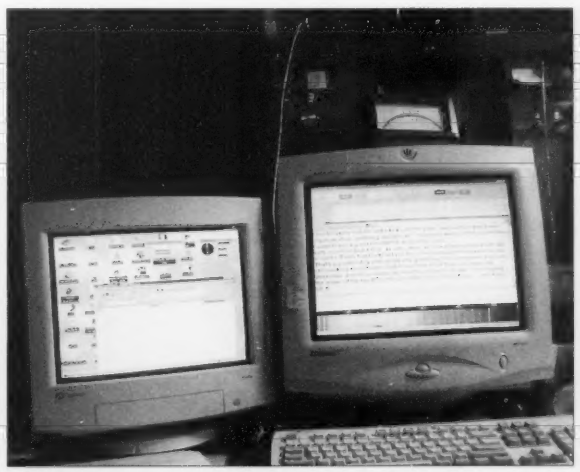

***Photo B.** Close-up view of MixW in the monitor on the right, with a word processor running in the left monitor. Notice that most of the desktop is still viewable.*

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Travels with Henryk — Part 14

Do Not Pass Go(a).

This small part of India is particularly interesting from the European point of view. Goa had been a Portuguese colony for some 450 years.

Until 1961, Goa had the prefix CR8, and one young amateur radio operator was particularly active there just before India took over. He was Luis Catulo ex-CR8LC. I met Luis in Lisbon, Portugal, in January 2002 where he is CT1CTZ today (**Photo A**). Luis is retired after many years of working for airport authorities in Goa (Dabolim), Sao Tomé (S92), and Portugal.

I arrived at the airport of Dabolim in Goa one early December morning. After a few days of getting used to the very striking colors, constant noise, and the smells of spices, I set out to search for local hams. I had a short list of callsigns and addresses I found on [www.qrz.com].

One day at the bus station I saw a sign with a name that looked familiar. I jumped into the bus and showed the address of Cyril VU2CY to the fare collector. He nodded "yes, yes" and announced my destination for other passengers, and soon a woman pointed to a newly built house and told me to follow her. But there was no antenna in sight. It was, however, Cyril's house, and he welcomed me to step in. His quad antenna was disassembled and his ICOM transceiver was in Bombay for a memory refreshment therapy. So

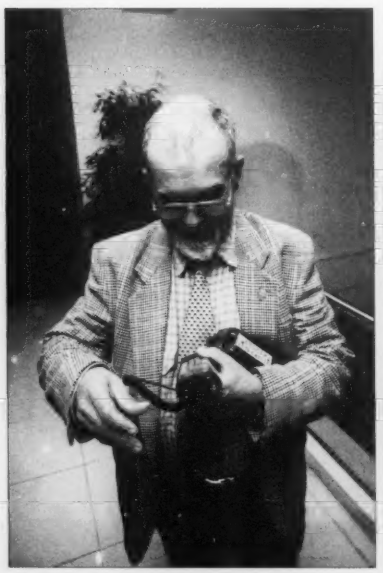

***Photo A.** Luis Catulo ex-CR8LC.*

***Photo B.** Cyril VU2CY.*

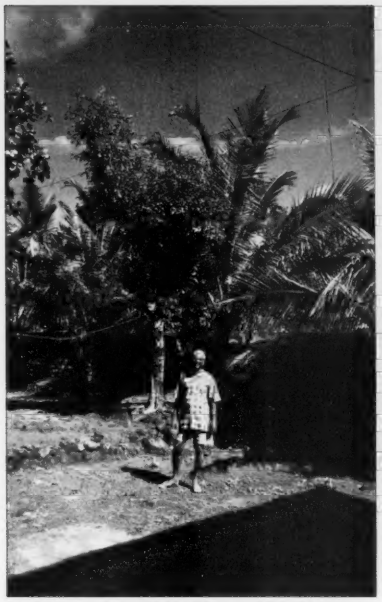

***Photo C.** Cyril VU2CY shows us where he strings his wire antennas.*

all he had to play with was a miniature QRP transmitter which he had home-brewed (**Photo B**), and a few dipoles among the trees (**Photo C**). Cyril, a retired engineer, knew other active hams in Goa and could help me get in touch with them.

It was not difficult to find Didier VU2DM. He lives in the center of the capital city of Panaji, and the roof of his big house bears a few antennas — a quad, a delta, and a dipole (**Photo D**). His radio desk is quite impressive by Goan standards (**Photo E**), and evidence of his successful DXing, in the form of amateur radio diplomas, is on the wall. Didier knows Luis Catulo (ex-CR8LC), and they keep in touch, but his amateur radio interest started after Luis had left Goa.

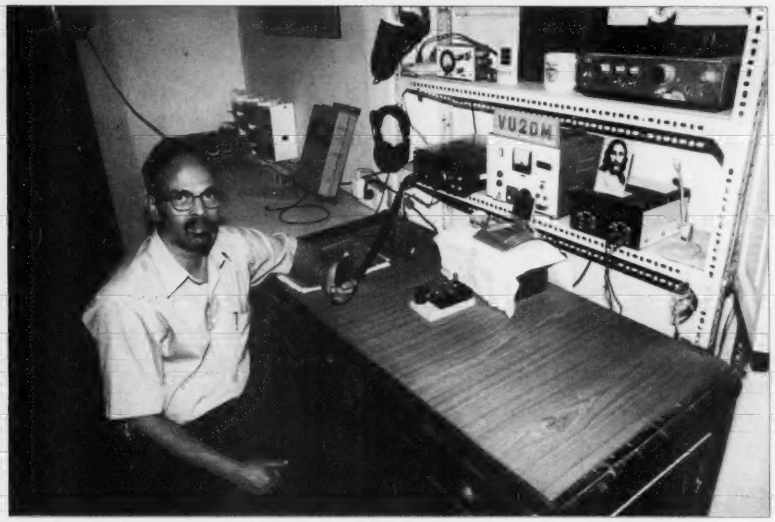

***Photo E.** VU2DM takes a break at his operating station.*

The youngest of the trio, as I could only pinpoint three hams in Goa, is Alex VU2FCX. I took a taxi to get to his QTH, as the phone number I got from Cyril was obsolete. Unfortunately, Alex was not at home when I got there, but I persuaded his wife to sit by the radio and pretend to talk to other housewives (**Photo F**). Actually, it is their 5-year-old son who likes to play radio amateur sometimes when Alex is away, but he presumably knew that this is not on his father's favorite list of things for him to do, so he refused to be photographed at the radio. Alex has a number of wire antennas (**Photo G**) and a Yaesu transceiver — a model that is very popular in India because of its small size and low cost.

Average income is quite low in India, and a radio transceiver is an expensive item here. The licenses are

Continued on page 59

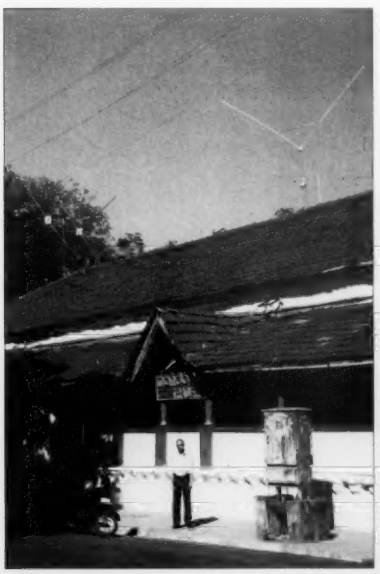

***Photo D.** The home of Didier VU2DM has several antennas on the roof.*

***Photo F.** The wife of Alex VU2FCX models his ham radio equipment for us.*

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Easy Audio Tracer

How does this project sound?

Here is an easy-to-build project to build an audio tracer, an electronic device found on many technicians' benches and used to trace the audio path through a given piece of equipment. This simple project will provide a valuable work tool for the amateur builder, at little or no cost.

Computer systems have a way of becoming extinct shortly after the final payment is made or immediately after you learn how the software works. Whichever comes first! Without this phenomenon, there wouldn't be a trail of "orts" left after the new system has been installed.

Part of the replaced system is often a pair of speakers, one of which is powered by a DC wall transformer. This unit, or at least the pairs I have disassembled, contain a decent audio amplifier board with the usual controls, such as volume, bass, treble, and balance. The builders designed them to be "cost effective" (i.e. cheap), yet provide a decent level of audio with acceptable quality. What a shame it would be if this technology were ignored and trashed.

Having adequate test equipment available to troubleshoot your latest project is a must for the amateur builder. Having to purchase equipment can be costly, even if used items are found at hamfests, etc.

Why spend the money for an audio tracer when there's a totally adequate device waiting for minor modification for you to use! And the appearance is pleasing, too!

This is a very easy project to complete. The manufacturer did most of the work for us. All we have to do is modify the "audio input cable" to meet our needs. **Fig. 1** shows a typical amplified speaker. **Fig. 2** shows the attachments associated with the speaker. The input audio cable, either the one that fed audio from the audio board in the computer or the "jumper" that attached the second speaker to the first, has been modified.

The input jack on my speaker is an

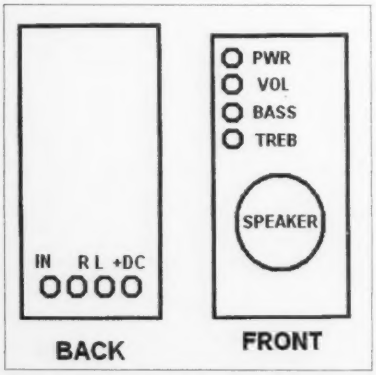

Fig. 1. Typical computer speaker pair. Inside is an audio amplifier.

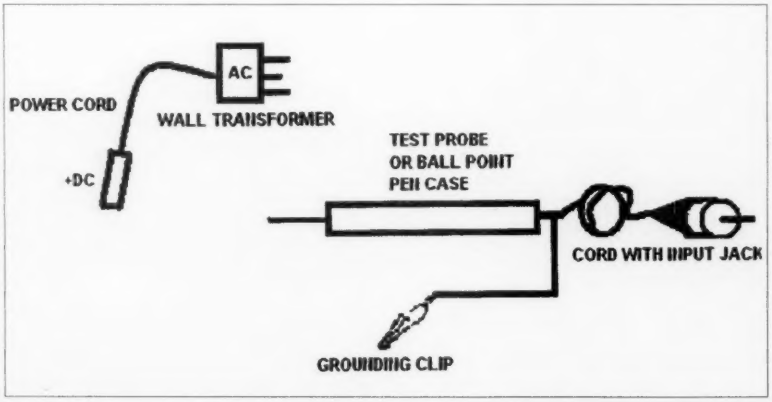

Fig. 2. Attachments, DC power source and modified audio cable with test probe attachment.

RCA type and remains untouched. The other end (another RCA jack, though it could also be a mini stereotype plug) was removed. Parts required for the test probe are minimal. I used an old test probe I had, but a recycled ballpoint pen case works just as well.

Strip the outer jacket of the audio cable, taking care not to cut the shielding braid surrounding the inner conductor. I use the term "shielding braid" loosely, in that the cables used for computer audio are notoriously flimsy. Enough of the insulated center conductor should be exposed to extend through the test probe.

A solid wire test point (made from a 2" piece of house wiring) is soldered to the end of the center conductor. Feed the center conductor with the test point through the test probe and hot glue or epoxy it in place. File the end of the test point to a suitable point, and the working end of the probe is complete.

A ground clip must be attached to the shielding braid. Being "frugal" (my XYL says "cheap"), I salvaged a length of copper braid from the degaussing coil from a discarded TV set and soldered it to the frail shield on the audio cable. Be careful doing this: The audio cable isn't friendly when too much heat is applied for too long! Use hot glue or epoxy to attach the ground assembly to the far end of the test probe. This will provide a measure of "strain relief" for the shielding braid.

Finally, attach your choice of grounding clip to the copper braid. I used an "alligator clip," or "croc clip" in the English publications. The choice of clamp is yours no matter which choice of reptilian description you care to use.

And there you have it. One audio signal tracer completed for the price of nearly nothing! Attach the test probe and cable to the audio input, plug in the power transformer, and begin chasing audio through your latest venture!

A word or two of caution: (1) Turn the audio gain DOWN before touching the probe to the circuit being tested. You will be amazed at how good these audio amps are! And (2), make sure that you have put the RCA jack into the proper input on the back of the speaker. You'll wait a long time to achieve results if you choose the wrong input. No, I won't admit to this one, but I do know about it, don't I?

Happy building! 73

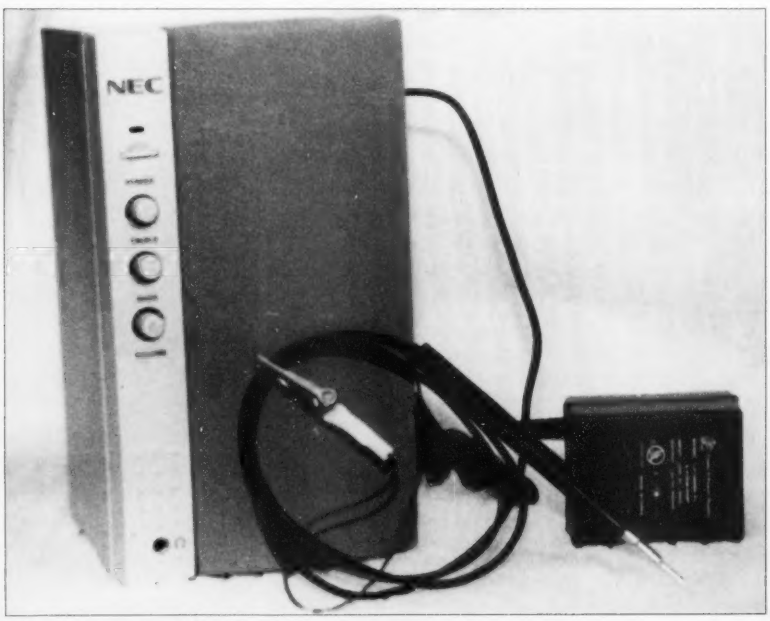

Photo A. *Easy Audio Tracer.*

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G.I. Joe and Mr. Morse

Try telling the military that Morse code is dead.

MORSE CODE IS DEAD! Or so says the fictional future headline if some Morse code nay-sayers have their way. Morse code is, in fact, not dead, and is in constant use throughout the world even now. Surprised?

While Morse code use has declined over the past several decades, Morse code is as vital to passing critical communications traffic, under special circumstances, as it has ever been.

Admittedly, Morse code use in mainstream communications has declined. In the 1990s, the U.S. Coast Guard discontinued monitoring the HF bands for SOS signals. Ships installed satellite communications consoles and removed Continuous Wave High Frequency (CW HF) radios. Morse code proficiency requirements were reduced in amateur radio, and a global movement continues to try to eliminate altogether the requirement for Morse code proficiency for access to amateur radio HF bands.

Significantly, the average age of those truly proficient in the use of Morse code is increasing. To many, these events denote the demise of this once-critical method of communications. However, there is some additional information about Morse code that is not generally known. Morse code is still used in many areas of the U.S. military, foreign militaries, and others.

In fact, Morse code used over CW HF is still a critical communications method under circumstances where no other means will work. Morse code over CW HF is a vital, viable communications capability that is as necessary in the 21st century as it was during the 19th and 20th centuries. The fictional headline *should* really read, MORSE CODE LIVES ON!

Through several wars, Morse code was key to communicating on the battlefield, in the air, and aboard ship. Many current amateur radio operators learned their Morse code skills in World War II, or in later military service, and have refined those skills since then. I am relatively new to amateur radio and Morse code, having started in March of 2002 with my first HF QRP station and my first Morse code HF contact.

Since then, I have made approximately 160 QRP QSOs with operators up and down the East Coast, throughout the Midwest, and in Canada, Bermuda and the Virgin Islands. In a few instances, I have had the good fortune to "talk" to operators who were literally part of history as it was being made. One in particular was a communications operator with the army during the invasion of North Africa during World War II.

One of the key reasons I was drawn to Morse code is the ability to communicate with those who are part of our history. It is almost like reaching back into time. However, just because Morse code originated in the 19th century does not mean that it is obsolete today.

While it is a fairly well known fact that the military has used Morse code heavily in the past, many people believe that it has largely abandoned Morse code in favor of other, faster, more sophisticated means of communications. This is not at all true. Like the rest of society, much of the military has moved on to faster, higher-bandwidth modes for passing voice and data. Even with the high technology used in today's military, there are niches that lend themselves to simple, reliable methods of passing messages over long distances. I know from personal experience and research that the capability to send and receive Morse code is retained in the military, is still being trained in military schools, and is in use today in various military theaters throughout the world. Morse code is still a part of the U.S. military.

There are a number of military occupational specialties that either use Morse

code as part of a primary skill (primary job) or as an additional skill (secondary job). This fact cuts across all services. We all saw the army Special Forces in Afghanistan and Iraq moving around the countryside, organizing Afghan and Iraqi military resistance, taking down objectives and generally making life hard for the bad guys.

Army Special Forces have a military occupational specialty of 18E, communications sergeant, requiring proficiency in Morse code using CW HF as one of the job requirements. The 18E Basic Non-Commissioned Officers Course contains instruction in basic and advanced International Morse code.

The performance standard for success is 13 code groups per minute. This would not be required or trained if it were not an absolute necessity. Training time is at a premium and unneeded skills are not maintained as requirements for army specialties. Given the capability to pass message traffic using Morse code over HF with low power and minimal equipment, it is not hard to imagine why army Special Forces keeps Morse code in its inventory of very special skills.

Army Special Forces is not the only elite military unit in the army using Morse code; army Rangers, in some cases, do use it as well. I was browsing a Morse code key manufacturer's Web page one day and found they were offering military-style keys for sale. The keys were part of an army contract overrun. The keys were advertised as having been sold to the army for use specifically by army Rangers.

Now this may have been a ploy simply to sell keys, but given some of the missions army Rangers are called on to perform, Morse code over HF works just as well for them as for army Special Forces. The army also has other specialties that train and use Morse code today but for different reasons.

The army's Military Intelligence branch has a specialty called 98H, Communications Locator/Interceptor, and, to paraphrase from the [www.goarmy.com] Web page, the soldiers in this specialty are primarily responsible for performing and supervising the detection, acquisition, location, and identification of foreign communications using International Morse code.

This is only one part of the specialty, but it is mentioned first on the list of duties. In addition, operating signal intelligence/electronic warfare equipment to detect, acquire, identify, locate, and exploit foreign communications devices transmitting Morse and non-Morse signals is also mentioned as key parts of this specialty.

You may ask why we need Morse code–skilled intelligence analysts in today's world. The reason is that much of the rest of the world still depends on Morse code to pass messages and perform vital communications functions for various militaries on a daily basis. The army is not the only service that still trains and maintains Morse code skills. The air force, navy, and marines do as well.

The air force requires Morse code in at least one specialty area, the Air Force Signals Intelligence Production Specialist. The Signals Intelligence Production Specialist must use the International Morse code and receiving and recording equipment to interpret these signals.

This specialty lists 27 semester hours of basic Morse code as part of the prerequisite training courses. For training in Morse code, the air force has specific Morse code training listed in the Community College of the Air Force 1999-2001 catalog for Morse code. The course title is listed as COM 1412 International Morse code and is described as basics of International Morse code with laboratory.

The air force also maintains a Special Experience Identifier (SEI) for Morse code proficiency. It is listed as SEI 378, Morse Code Qualified. To be awarded this Special Skill Identifier, you must be able to transcribe 12 groups per minute Morse Code.

Along with the army and air force, the navy and the marines also have Morse code requirements that are still trained today.

The navy has one job that is trained in Morse code: Signalman SM. The Signalman stands watches on signal bridges and sends/receives messages by flashing light, semaphore, and flags. Training for this specialty includes lectures and practical exercises covering visual communications procedures and International Morse code.

In conducting research for this article I could not find any references to whether navy SEALS use Morse code. Given that the army's Special Operations Forces use Morse code, I expected to find that the SEALS would be using it as well. However, I could not find any references that indicated this was the case. I checked with the course manager for the Naval Special Warfare Communications course and he confirmed that the navy SEALS do not use Morse code and do not train it any longer, a fact that he did not necessarily agree with.

However, as course manager, he demonstrates Morse code to course attendees and strongly encourages all course attendees to become qualified on their own — as he believes that when all else fails, Morse code over CW HF will get through.

Along with the army, air force, and navy, the marines also retain Morse code skills. The marines have a military occupational specialty of 2621 titled Communications Signal Collection/Manual Morse Operator/Analyst. This specialty requires the completion of the Communications Signals Collection and Processing Course and the Morse Intercept Operator Course as two of the prerequisites.

Holders of this specialty perform communications electronic signals search missions, record the intercept of signals using electronic means, and measure, classify, and evaluate the signals. Operators must be familiar with communications intercept receivers, specialized computer software and hardware, and wideband converters in the process of collecting, recording, analyzing, and reporting a wide variety of intercepted communications signals.

While the marines and air force are primarily focused on transcribing Morse code as part of gathering intelligence, the army and navy still train and use Morse code to send traffic. The army is the only service that still

uses and maintains a capability of sending and receiving Morse code using CW HF.

While the military continues using Morse code, what use does the civil communications community have for it? The surprising answer is that the FCC still requires Morse code proficiency for some non-amateur licensing.

With all the discussion heard periodically about the "demise" of Morse code and the push to eliminate it from amateur radio as a requirement for HF band access, we are led to believe that the FCC has abandoned Morse code as a requirement in commercial licensing. This is not the case.

The FCC is still licensing First Class, Second Class, and Third Class Radio Telegraph Operators. Each of the Radio Telegraph Operators licenses requires that the applicant pass two Morse code Elements. Third Class and Second Class Operators are required to pass the 16 code groups per minute and 20 code groups per minute test. First Class Operators must pass the 20 code groups per minute and 25 code groups per minute elements.

Telegraph exams consist of both transmitting and receiving tests. Examinees must copy by ear and send by hand plain text code groups in the International Morse code using all the letters of the alphabet and numerals 0–9, as well as punctuation and prosigns. Those seeking certification must copy and send at the required speeds for one continuous minute without errors. The test is five minutes long.

According to the FCC Web site, the failure of any code test automatically terminates the examination. That the FCC is still dedicating resources and giving license exams for commercial radiotelegraph licenses requiring Morse code is another indicator that perhaps Morse code is not yet ready to be put on the shelf.

There is other evidence that Morse code is not yet relegated to the history books. In the world's militaries, there are many examples of HF capable radios that have CW HF (and Morse code) capability.

Jane's Military Communications 2002-2003 indicates that many countries possess CW HF capability. Australia has an HF radio described as the HF-90 Manpack HF/SSB/ECCM Transceiver. It uses the upper sideband, lower sideband, CW HF, frequency shift key, and ECCM modes. Accessories that come with this radio include a Morse code key.

Interestingly, this radio was not introduced until 1996. In the military, that makes this radio a fairly new addition to the inventory and one that will be around for decades. *Jane's Military Communications* further notes that many countries have radios and equipment that support CW HF. They include: Australia, Bulgaria, China, the Czech Republic, Egypt, France, India, Iran, Israel, the Russian Federation, South Africa, Italy, United Kingdom, and the United States.

Given that many other countries use equipment manufactured by one of the nations listed, I suspect that there are many more nations that also have CW HF capable equipment. In fact, the above-named radio built by Australia is listed as being in use throughout Africa, China, Europe, the Confederation of Independent States region, India, and southeast Asia. Given the prolific nature of military equipment sales to the world's armies, it is a fair assumption that CW HF–capable equipment is still in the equipment inventory of most nations. And given the proliferation of CW HF–capable radios, you can also assume that a fair number of countries are still practicing Morse code over CW HF as an operational communications means.

From my experience working within a multinational coalition of military forces, I know that Russia is a big user of CW HF and Morse code — perhaps, the biggest user in the world today.

In talking with visiting Russian communications personnel, I find that they consider Morse code over CW HF an extremely important capability and train hard with it on a continuous basis. I suspect that the Confederation of Independent States also heavily uses Morse code over CW HF given their relatively recent association with the Russian army.

Another country's military still using Morse code, albeit not as much as Russia, is the United Kingdom. Again, visiting communications personnel supporting communications in the British government state that Morse code is still a communications method in use in their armed forces. While it is somewhat difficult to ascertain with any certainty which of the various nations are actually training and using Morse code in their militaries, you can determine who is making and using Morse code equipment such as CW–capable radios as mentioned above and also Morse code keys/bugs.

With respect to the latter, the United States, China, Ukraine, United Kingdom, and some Eastern European countries all offer surplus military Morse code keys and bugs to the open market via third parties. Much of the equipment is newly manufactured. For countries with scarce resources, such as those in Eastern Europe, there must be a reason for the equipment to continue in production other than just selling it to secondary markets, and I suspect it is because of the domestic requirements of a given country's military. With various countries, including the United States, still employing Morse code over CW HF as a part of their military communications capabilities, a reason must exist that causes them to retain this well used method of passing messages. Perhaps it is because Morse code over CW HF can provide critical communications during times when more "up to date" modes can't get through.

An Army Signal Corps general once said, "Newer isn't always better. Even though it is old and slow, Morse is still the most reliable in difficult conditions." Even though the aforementioned general retired over ten years ago, his statement remains true — especially when the dependence on satellites, mobile communications devices, and personal wireless devices grows daily.

Several years ago, a satellite failed over the United States and caused one key service provider's paging network to cease operating. Tens of thousands of customers were left with no messaging

capability. This caused havoc with all who depended on the service, and the failure received large amounts of media coverage worldwide.

All this happened because one satellite failed. Now magnify that by the over 2,000 satellites aloft today that provide paging, data relay, voice relay, radio link relay, global satellite phone, mobile phone, etc., etc., and you have an idea of the magnitude of the disaster that would occur if we lost those satellites, even for a few hours. If the incident noted above had been related to electromagnetic pulse from a high altitude nuclear "accident," very little non-landline communications would be possible, and probably very little landline communications as well as much of the electronic infrastructure and most transistorized devices would be inoperable.

Electromagnetic pulse is a very strong burst of electromagnetic energy that can literally burn out small circuits, transistors, and components. While humans and animal life are left unscathed, unshielded electronics are rendered inoperable when exposed to an EMP event. In fact, for the first several days after an EMP event, only a mode that could work through high atmospheric noise levels and most likely with simple, construct-it-yourself equipment would get messages through.

Morse code over CW HF is recognized as a superior means of communications for both reasons. Simple, low-power CW HF transceivers, such as those used in QRP, are an ideal example of how to continue communicating after an EMP event.

If you work QRP (or even if you don't), you probably know that with a few pieces and parts scavenged from cast-off electronics devices, you can build a functional CW HF transceiver capable of sending and receiving Morse code transmissions. You need to have some knowledge of circuits and radios to successfully build such a rig, but many in the amateur radio community have this kind of knowledge.

With a minimal working knowledge of Morse code and low-tech transceivers, amateur radio operators could pass message traffic even after EMP rendered all other communications inoperable.

There is a saying from Napoleon I's *Maxims of War,* written in 1831: "The secret of war lies in the communications."

While this is a bit extreme for an amateur radio article, the meaning is clear: We, as communicators, operators, and amateur radio advocates, should pursue skills that make us better at what we like to do, and also grow our skills. Learning and using Morse code and transmitting via CW HF and a key of some sort can make you a better operator, a more knowledgeable one, and more valuable as an emergency communications op — as well as a more capable one.

I don't think that anyone will argue with advocating continual development of amateur radio operator skills. We should all strive to learn more regardless of what our favorite mode is. Using Morse code over HF is fun, rewarding, and interesting. I will always remember my first HF Morse code contact and have had numerous other contacts since then that are also quite memorable. Morse code continues to challenge me and keeps amateur radio interesting.

Morse code is not dead. Far from it! It is still a means of passing message traffic in the U.S. military for some of our most skilled soldiers, and is still trained in U.S. armed forces schools. Many foreign militaries maintain Morse code proficiency as a primary means of passing critical military message traffic. Virtually every military is maintaining radio equipment in its inventory that has CW HF as a mode and is capable of sending Morse code.

Morse code over CW HF works well in very noisy conditions and could be the only means available if we find ourselves the victim of an electromagnetic pulse event or some other unforeseen disaster that makes our usual communications modes unusable. Under extreme circumstances, Morse code over CW HF can pass messages when no other method can get through.

As individuals we need to develop and maintain our proficiency in sending and receiving Morse code just as if we plan on using it in some future emergency.

Many will look at this as very far-fetched. Most would have had the same thoughts about what happened on September 11, 2001. We need to ensure that we are ready for the next incident regardless of what that may be. Being prepared by learning Morse code is a small price to pay to ensure that we can continue to pass critical message traffic under less than optimal conditions.

After all, if the U.S. military deems Morse code skills as still being essential, perhaps the amateur radio community should as well.

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Continued on page 59

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MFJ and the CW Jedi

An iambic beginner tries out the MFJ-564 paddle.

Wanting to join in on the recent QRP craze, I needed to get my CW code skills back into shape. Recently I stumbled on a CW tutoring program called MRX Morse Code. One of the features of MRX is that it allows you to not only practice copying Morse code, but to send it as well.

To practice sending code, a straight key, the computer key board, or an iambic key interfaced to the computer can be used. Details on key interfacing to the computer are included in the help section of the MRX software.

I had never used an iambic key before. To be honest, for me this was some sort of elusive mystery tool of the CW Jedi masters. I didn't even know for sure what iambic keying really was. I found out that, in a nutshell, it is the use of an electronic keying device that makes dits and dahs for you.

The most popular input device to the electronic keyer is the iambic key, or "paddles" as they are often called. Most of the newer radios have the electronic keyers already built-in. If you have an older rig, you can easily build your own keyer, or buy a prefabricated one. Most electronic keyers allow you to easily vary the speed and weight of the characters set to match the code speed with which you are comfortable. Many have built-in memory, so you may never have to repeatedly call CQ CQ CQ again.

Originally I learned code with a straight key, and I knew they didn't call it "brass pounding" for nothing. After playing with the MRX program for a while, I figured, Hey, this iambic thing is here, let me play with it on the keyboard and see what it's all about. I was wondering why I had never tried this before, because it makes sending so much easier!

The biggest differences are that less physical movement is needed to send characters, the electronic keyer makes perfect dits and dahs for you, and it's just plain fun. It takes 132 key closures to send the entire alphabet and numbers 0–9 with a straight key. With an iambic paddle and keyer you can send the same number of characters with only 63 strokes!

For information on CW operation and iambic keying, I highly recommend that you check out PA3BWK's Ultimate Morse Code site. Be sure to read Chuck Adams K5FO's Iambic Sending article while you are there. Chuck describes the iambic paddles do's and don'ts, and offers setup and practice advice to get a beginner started on the right foot (or fist).

So now I was hooked, and I knew I would soon wear out my keyboard by virtue of sending so much code. I needed an iambic key, so I hit the 'Net and checked out some prices. Yikes! Most are $100 or better. After checking the reviews on the Internet, I narrowed my choices down to four models: the Kent, Bencher, MFJ, and, for portable QRP, the Vibroplex Code Warrior Jr.

The MFJ-564 was the only one in my price range. My impression from the Internet reviews was that this key was geared for people, such as myself, just getting started and on a budget. If you are one of the CW Jedi masters I spoke of earlier, then this may not be the key for you. I'm sure it is not going to equal a key costing two to four times as much. But I am also sure that it will get the job done.

I did learn that all keys have a different "feel," and what works for someone else may not work for you. I got the impression that if I were to continue working iambic CW, then I would eventually want one of the high dollar models anyway.

The MFJ-564 is manufactured by MFJ Enterprises. The current price is $49.95 for either the chrome or the black-finished base. The unit is available direct

from MFJ or from most of the major ham radio retailers. I ordered the MFJ-564 with the chrome base.

Physically the unit seems to be somewhat of a take-off on the Bencher paddle. My research made it clear that even though these units may look similar, they are not. You will find that Bencher paddles are held in very high regard among the iambic enthusiasts. And as always, you get what you pay for, but in this case I was more than happy with my purchase.

The key came well packaged and looked clean out of the box. The unit had no marks, chips, or dings. A one-page instruction sheet was included. For a newbie, the instructions leave some details out, and they could have been more in depth on the setup and adjustments. No adjustment wrenches were included.

However, adjustments are easily made with an Allen wrench and a Phillips screw driver. There are no adjustments for spring tension. I suppose that the spring could be shortened to achieve greater tension, but I don't really see the need. Now on to the setup.

The first step of the instructions said to loosen the bottom pivot arm screw so that the paddles are free when squeezed. The screws were already loose, and no other information was given as to their function. More on these screws later.

I started to do setup and adjustments to get a minimum of contact spacing and be sure the movement of the paddles felt right and everything lined up correctly. While doing this, I noticed the left paddle had an up and down rocking movement and the right one did not.

Further inspection showed that the pivot arm was not properly seated on the fulcrum points. The pointed needle bearings where the rocking fulcrum points are were spaced too wide for the recessed area of the nylon receptacle sockets in the pivot arms. This was causing the up and down sliding on the pin areas. I knew from my reading on using an iambic paddle that a very light touch and small contact spacing is desired to build speed. This vertical movement on the paddle could cause false keying with a small contact spacing and was unacceptable. However, it was easily corrected and not worth it to me to send the unit back for replacement. Here is all that was required to fix this problem.

First, I removed the spring and took the paddles and pivot arm assembly off. Next, I removed the main square block with just two bottom screws. One of the screws seemed to wobble like it was bent, but no problems were encountered. Next I used a very small adjustable wrench to gently bend the pivot pins (needle bearings) so the nylon brushing in the pivot arms fit squarely with no vertical play or sliding.

Once done, the pivot arm fit tight and square on the pins. Then I reassembled the key and finished my gap adjustment. Chuck Adams recommended a very small gap set with just a piece of 20 lb. copy paper. That seemed a bit too close for my taste, so I used a 3 x 5 index card to set the gap.

The pivot arm screws mentioned earlier in the first step were a bit of a mystery. After getting the basic setup done, I realized they are possibly overtravel screws. If you have a really heavy fist then you could bend the contact arms and thus change the contact gap spacing.

These screws can be set to serve as a positive stop to prevent bending the contact arms. On my unit one of the screws is very loose and the other still quite snug. I may try some Teflon tape on the loose one to add some extra friction. Finally, I soldered a cable to the provided solder lugs under the base and quickly interfaced it to my PC for practice. It keys just fine.

Although I had a few setup glitches, I'm happy with my purchase. I feel it was worth the investment. I have seen these same units sell on eBay for nearly what they cost new! I didn't mind the extra tweaking involved to get it set up correctly. I'm sure I will disassemble it from time to time anyway for a good cleaning. If you want to get started with iambic keying or want a paddle to kick around with then this is it. Hats off to MFJ for providing a quality and economical tool for the beginner. This is the only paddle of this type available in this price range that I am aware of. Pick one up and give iambic CW a try.

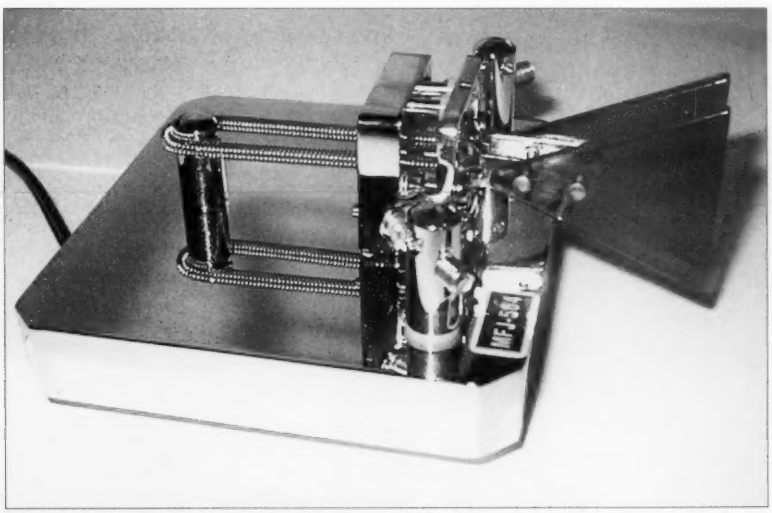

Photo A. *The MFJ-564 iambic paddle.*

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73

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The IC-703

Talk about choices! Right now, there's a slew of new HF transceivers on the market designed with the QRP operator in mind. This year at the 2003 Dayton Hamvention, Icom introduced their new IC-703 QRP HF transceiver.

The IC-703 is built on the same footprint as the Icom IC-706. In fact, Icom even states in their ads that the IC-703 uses IC-706 MKIIG operation instructions. If you have operated a 706, then the IC-703 can be operated without the manual.

So, just what is an IC-703? It's Icom's newest HF radio and their first entry into the QRP HF field. The IC-703 covers 160–10 meters. The IC-703 plus covers the above bands plus 6 meters. The IC-703 sports an internal antenna tuner that will tune balanced feed antennas (coax feed antennas, not random wire antennas) and the tuner requires no operating current once tuned.

DSP is also included in the IC-703. You get automatic notch and noise reduction built into the IC-703.

The IC-703 was put on an energy diet. On 9.6 volts, the current drain is only 300 mA! The IC-706 on the other hand consumed over 1.2 amps just on receive. The IC-703 is battery friendly. It's designed to work correctly with power supply voltage as low as 9.6 volts. Most of today's radios have a hard time running correctly when the power supply dips to 12 volts. I know my Ten-Tec Argonaut V gets upset at 12 volts. The IC-703 is a really good choice for portable operation with battery power.

Many modes of operation

The IC-703 can operate on SSB, CW, and AM and FM modes. The RF output on AM is four watts maximum.

The IC-703 also covers the entire shortwave spectrum. So, you can listen in on what's going on in the world as you backpack your way into the outback.

Other goodies inside the IC-703

Besides the stuff we now take for granted like dual VFO and memories galore, the IC-703 also comes with a TXCO so you won't drift around in frequency when the radio gets too cold or too hot. That's something to take into account if you plan on running the IC-703 inside a tent on a cold November morning.

Since most QRP operation is on CW, the IC-703 sports a CW memory keyer. The keyer will hold 3 memories of up to 50 characters each.

Normally when you're camping, you usually end up with less than perfect antennas, but the IC-703 can help you pull in those weak signals with its sensitivity of 0.16 µV at 10 dB S/N.

On the transmit side, the IC-703 will produce up to 10 watts of RF into a 50 ohm load. The IC-703 is smart enough to know when the battery voltage is dropping and will automatically drop the output back for you. The IC-703 will drop back to five watts at 9.6 volts.

Icom was able to get this and more into a package that tips the scales at four pounds four ounces. The entire transceiver is about six inches wide by two inches high. The IC-703 is about seven inches deep.

Putting the IC-703 on the air

If you have ever operated the Icom 706, then the IC-703 is child's play. They operate in very much the same manor, with minor differences between the two.

Putting the IC-703 on the air is quite simple, you select the band you want, the mode and away you go. There's no direct frequency input, so you must dial the frequency in with the main tuning knob. You can move up or down band by band by using the BAND buttons. You can program up to 105 memories with your favorite frequencies, making band hopping easier.

One of the drawbacks of the IC-706 is CW operation without the CW filter. Once again, this problem pops up with the IC-703. Even if you only do CW as an afterthought, the FL-52A (500 Hz) or FL53A (250 Hz) filter is a must have option. But there's a problem: You can only install one filter inside the IC-703. So, you must decide if you want one of the two CW-only filters, a 1.8 kHz SSB filter or a SSB wide filter of 3.3 kHz.

Speaking of CW, the IC-703 can operate in either full break-in mode or semi-break-in mode. The semi-break-in seems to work the best for me. All of the preferences for CW are set within the various menus.

The IC-703 is menu-driven and there are lots of menus to set up. One of the menus controls how the radio will operate on battery power. You can also configure the IC-703 so the backlighting can be turned on, off, or in automatic mode. This simple feature can really save your batteries!

Operation out of the box is quite easy, only after a few hours you will begin to configure the IC-703 to suit your own operating style.

There are so many features, it's hard to get into each one. For example, there's a simple band scope that will scan the band looking for stations. It's nice, but it does not exactly excite me.

There's a speech compressor for improved average talk power. Like every processor I've come across, sometimes turning it on works wonders, and sometimes there's not much difference. You can set the amount of compression to suit your voice and band conditions.

Operating the IC-703

Since I already own an IC-706, getting used to the IC-703 was very easy. I enjoy operating CW so I installed the 500 Hz crystal filter. It's not exactly plug-in, you have

to remove the top PC board and solder the filter onto the second PC board. There are quite a few plug-in headers that need to be removed before you can get to the second PC board. It's not for the faint of heart.

On the other hand, it's not as hard to do as it appears. As a matter of fact, I installed the CW filter in my IC-703 in the hotel room during the Hamvention.

Like I said earlier, if you even plan on doing a little bit of CW with this radio, the CW filter is a must. It's an expensive option at about $165. CW operation works without any problems and the ten watts was more than enough to work just about anything I could hear. SSB operation generated lots of good comments on the audio. I never tried the speech compressor while using SSB. I did work some DX on FM on the 29.6 calling frequency. Again, I received good audio reports while on FM. I have not tried the IC-703 on AM yet, but will give it a try on 7.290 this coming fall.

The receiver seems to hold up just fine on a crowded band, but I don't have the antennas to really bring in lots of extra strong stations. All in all, the receiver works just fine for my operating style.

I would have liked to have seen a few more AGC time selections. You can turn on fast AGC or normal AGC time constants.

The DSP works great! The automatic notch really cleans out the tuner uppers on SSB. The automatic noise reduction works fine, too. In fact it's better than the noise blanker at taking out engine noise. You can select how much noise reduction you want the DSP to work with via one of the menus.

The internal antenna tuner worked correctly with just about any antenna I tried. It does not have the tuning capacity of some of the outboard automatic tuners, so don't expect it to tune your 20-meter dipole for 160-meter use. You can turn off the automatic tuner and run the rig straight through if you like.

The IC-703 comes with power cable, microphone, and instruction booklet.

Nits to pick

With a radio that has so many features, it's hard not to get trapped in the menus. There are so many menus, you can get lost. So unless you play with the radio all the time, you had better keep the manual nearby. For example, the IC-703 contains an automatic serial number generator for CW contests. You have to dig into the manual to figure out how to make it work. It's not intuitive when it comes to the oddball things that this radio is capable of doing.

You can only install one internal filter. That's bad. But on the other hand, at $160 a pop or so, you could not afford to put in more than one. Unlike my Argonaut V, with it's 35 DSP-based filters, the IC-703 is limited to just one crystal filter.

The power connector is attached to the radio via a flying lead about nine inches long. Why? There just had to be room for a power connector on the rear apron of the radio. But guess not. Anyway, the power leads are about nine inches long and terminate into an Icom-style power connector. The other end plugs into this arrangement and then to your power supply. Overall, there's about eight feet of wire to go to the power supply. The Icom IC-703 uses the OPC-1229 power cable.

What's good?

The ability to operate on battery power is an outstanding advantage to most of the other radios out in the market place. Hats off to the designer at Icom for taking this important step. The size of the radio makes for easy operation. Unlike the FT-817 with its super small knobs and tiny display, the IC-703 feels like a grown-up radio. Granted, the FT-817 can be slung over one's shoulder and operated from the internal batteries while the IC-703 cannot. (OK, you can mount the IC-703 into Icom's new LC-156 multi-bag.)

I am out of space this month, so next time we meet, I'll have some more info on the new Icom 703

The NEW second edition of the *HW-8 Handbook*

The second edition of the *HW-8 Handbook* is now shipping. It's a complete redo of the book. I've included lots more information on the HW-7, HW-8, and the HW-9. There's PC board overlays for all three radios, company service bulletins, and complete alignment instructions. I've kept the most popular modifications and added new ones. There are photographs through the new book as well as "Heathtips" for those little things that make life easier.

The new book is spiralbound so that it lies flat on the workbench and is printed on 80-pound paper. The second edition of the *HW-8 Handbook* should be on everyone's shelf.

You can get your own copy for only $15 plus $4 for priority mail shipping. Send a check or money order to the address at the top of the column. I'll pop one in the mail as soon as I get your order. 73

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AOR Introduces AR-ONE Receiver

AOR USA has announced the availability of the AR-ONE, a new wide-range communications receiver capable of monitoring any frequency from 10 kHz to 3.3 GHz with excellent sensitivity while providing maximum user flexibility. An earlier planned introduction of the AR-ONE was delayed, but AOR reports that units are now flowing into the marketplace.

"The AR-ONE Communications Receiver was designed and built with the monitoring professional in mind," said Takashi "Taka" Nakayama KW6I, Vice President of AOR's North American operations. "It can stand alone as a highly accurate receiver or it can support secondary signal processing, spectrum display units, and computer signal analysis."

The AR-ONE has two RS-232C ports on its rear panel. "This will allow the joining of multiple AR-ONE units. As many as 99 AR-ONE receivers can be controlled by a single computer."

The AR-ONE was conceived as a "breakthrough" design. Its many features include ten VFOs; 1,000 memory channels; an ultrastable frequency reference oscillator; selectable tuning steps and resolution down to one Hertz (Hz); the ability to monitor AM, NFM, WFM, USB, LSB, CW and data modes; a triple-conversion superheterodyne front end; adjustable BFO; high intercept; multi-IF signal output ports at 10.7 MHz or 455 kHz; and more.

Operating features include the ability to control all functions by computer and most functions through the control head. The unit can communicate many settings and readings to the user, including such items as signal bandwidth and the strength of a received signal.

The rear panel has two RS-232C ports, an "N" connector antenna terminal, two BNC inputs, power input, speaker output, and the IF taps.

"The AR-ONE is designed for professional users, such as governments, military applications, law enforcement, laboratories, and others who require the ultimate in a sensitive, wide-range receiver," said Mr. Nakayama. "At this time, we do not have plans to produce a version of the AR-ONE that has cellular frequencies blocked, so it cannot be offered for sale to the general public in the USA," he said.

With the ability to link up to 99 receivers, the AR-ONE may be an unparalleled resource for surveillance operations and high-end monitoring. The unit can be installed in base or mobile operations.

The user has the flexibility to tune in increments of a single Hz, making most of the widely used available RF spectrum tunable to the AR-ONE. Its ability to readout signal strength in user-selectable dBμV or dBm units makes direction finding more scientific, and its ultrastable frequency reference brings a lab-quality readout to the user in day-to-day operations.

Rear panel IF outputs allow for secondary signal processing and analysis. In addition, other accessories or computer programs make visual signal display possible, including graphic displays.

"The AR-ONE may well redefine what is possible in terms of monitoring," said Mr. Nakayama. "We believe governments need enhanced tools for surveillance to keep pace with communications developments, particularly as applied to Homeland Security. One area of interest is the ongoing battle against terrorism across the world. We hope the AR-ONE can play a role in bringing those efforts to a quicker conclusion."

Specifications

Model: AR-ONE

Configuration: Triple conversion superheterodyne

Frequency coverage: 10 kHz – 3.3 GHz (no gap)

Receive mode: AM, NFM, WFM, USB, LSB, CW, data

Sensitivity (AM mode — 10 dB S/N; NFM mode — 12 dB SINAD; CW/SSB mode — 10 dB S/N): 10–40 kHz — CW 22.3 μV; 40–100 kHz — AM 4.5 μV, CW 1.5 μV: 100 kHz–2 MHz — AM 2.5 μV; 2–40 MHz — AM 1.5 μV, SSB/CW 0.7 μV, NFM 0.89 μV; 40 MHz–1 GHz — AM 0.89 μV, SSB/CW 0.4 μV, NFM 0.5 μV, WFM 1.5 μV; 1 GHz–2.5 GHz — AM 0.7 μV, SSB/CW 0.32 μV, NFM 0.4 μV, WFM 1.5 μV; 2.5 GHz–3 GHz — AM 0.9 μV, SSB/CW 0.35 μV, NFM 0.5 μV, WFM 1.5 μV

IF frequencies: 1st IF — 754 MHz/265 MHz; 2nd IF — 10.7 MHz; 3rd IF — 455 kHz

Frequency steps: Standard steps — 1, 10, 50, 100, 500 Hz; 1, 5, 6.25, 9, 10, 12.5, 20, 25, 30, 50, 100, 500 kHz. Nonstandard steps: less than 1 MHz (1 Hz incremental)

Selectivity (B/W, –3 dB. –60 dB, in kHz): 0.5, >0.5, <2; 3, >3, <6; 6, >6, <20; 15, >15, <40; 30, >30, <70; 110, >110, <450; 220, >220, <600; 300, >300, <900.

Spurious sensitivity: >60 dB

Adjacent selectivity: >55 dB

Dynamic range: >70 dB

Unwanted spurious emission: <-57 dBm

3rd IP: >+2 dBm

Frequency stability: ±0.1 ppm (-10–50 C)

THD: >20 dB (<10 %)

Audio output: 1.5 W (at 8 ohms, THD <10 %)

Power requirement : 13.5 V DC, <1 amp (@ 1 W audio output)

Antenna impedance: 50 ohm

Antenna connector : N-type

IF output level : –20 dBm (10.7 MHz)

External frequency standard input: 10 MHz

Control interface: RS-232C

Operating temperature: -10–50 degrees (C), -18–144 degrees (F)

Dimensions: 157 (w) x 58 (h) x 221 (d) (mm), 6.2 (w) x 2.3 (h) x 8.7 (d) (inches) (main unit only, projections excluded)

Weight: Approximately 1.8 kg (4 lbs.), main unit only

(Specifications are subject to change without notice or obligation.)

NEVER SAY DIE

continued from page 9

there have been a few, but by far the most valuable education for me was the Navy's nine-month electronics course. And it was fun, too. I loved it!

Other courses that stand out in my memory were those in reading music and art appreciation at the Longfellow School in Pennsauken, NJ, in the second and third grades, and the art course at Erasmus High School in Brooklyn, NY. It was that same course, taught by the same teacher (Mr. Dockett), that got my mother interested in being an artist, going on to Pratt Art Institute and a career in commercial art.

You know, I'd like to see teachers start

Continued on page 62

CALENDAR EVENTS

Listings are free of charge as space permits. Please send us your Calendar Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the November issue, we should receive it by August 31. Provide a clear, concise summary of the essential details about your Calendar Event.

AUG 2

ALFARATA, PA Juniata Valley ARC Hamfest, 6:30 a.m. General admission, 8:00 a.m. Morning and noon food items available. Admission $2.00 donation, XYL and children free. Tailgating $5.00 donation, includes admission. Indoor tables, $10.00 donation per table. Space is limited. Vendors responsible to collect PA sales tax. Electricity, $2.00 additional. Please bring your own power cords. Directions: The Decatur Fire Co. is located along US Route 522 North, 8 miles east of Lewistown, PA in the town of Alfarata, PA. Look for signs. Talk-in on 146.910 MHz. *For more info, contact JVARC, PO Box 73 Yeagertown PA 17099, or contact Cliff Bell WB3IVX, 717-248-2616.*

AUG 10

GREENTOWN, IN The Greentown Hamfest Committee will hold their 6th Annual Greentown Hamfest Sunday, August 10th, 7:30 a.m. to 1 p.m. at the Greentown, Indiana Lions Club Fairgrounds. Talk-in on 147.24 and 146.79. Vendors preregister by sending a form or E-mail to [k9nqw@arrl.net]. Check the Web site at [www.grantarc.com/greentown.html]. Handicap parking will be available. Anyone who obtains a license or upgrade at our VE exams session will be admitted free. Tickets are $4 in advance and $5 at the door. 17-years-old and under free. Vendor setup is on Saturday at 6 p.m. to 8 p.m., and on Sunday 5:30 a.m. to 7:30 a.m. Inside tables $8 plus ticket; tailgate setup $3 plus ticket. Make checks payable to *Greentown Hamfest*. Contact *Greentown Hamfest, c/o L.B. Nickerson K9NQW, 517 N. Hendricks Ave., Marion IN 46952*. Phone *765-668-4814*.

PEOTONE, IL The Hamfesters Radio Club is proud to announce that they will hold their 69th Annual Hamfest Sunday, August 10th, at the Will County Fairgrounds (I-57 Exit 327 East) in Peotone. The air-conditioned, fully enclosed pavilion ensures you a good spot, rain or shine, hot or not. This hamfest is vendor friendly. Saturday setup from 3 to 11 p.m. (August 9th). Convenient unloading and parking areas. Free overnight parking. A secured building. The fairground offers plenty of free parking and there are ample food and rest room facilities. Tables are $15 each, electric $10. One ticket free per vender. All others $5 in advance, $6 at the gate. Your gate pass will be issued at arrival, your ticket will be needed. Gate opens at 6 a.m. Sunday. Main Exhibition Hall opens at 8 a.m. sharp. Send reservations and donations to *Robert Nelson WB9WFR, 1720 Vollmer Rd., Flossmoor IL 60422*. VE exams will be available. Visit the Web site at *[www.hamfesters.org]* for more info.

AUG 16

CHANUTE, KS The Chanute Area Amateur Radio Club Hamfest will be held on August 16th at Zion Lutheran Activity Center, 1202 West Main. Admission $2. Talk-in on 146.745 (tone 100) rptr. Contact *Keith Rather 620-431-0930;* or *Charlie Ward 620-431-6402*.

OAKLAND, NJ The Ramapo Mountain ARC will hold its 27th Annual Ham Radio and Computer Flea Market on Saturday, August 16th at the American Legion Hall, 65 Oak St., Oakland NJ. This event is ARRL sanctioned. Vendors setup at 6 a.m., buyers admitted 8 a.m. until Noon. The kitchen opens at 7 a.m. Talk-in on 147.49/146.49 and 146.52 simplex. Donations $5 with XYL and harmonics admitted free. Inside tables $12 each. Tailgate spaces $10 each. For more info please contact *Bob Anderson K2BJG, 69 Page Dr., Oakland NJ 07436*. Phone *201-337-6945;* fax *973-962-6210*. Club E-mail *[rmarc@qsl.net*. Club Web site *[www.qsl.net/rmarc]*.

SPANAWAY, WA The Radio Club of Tacoma (W7DK), will hold their 2003 Hamfest at Bethel Junior High School in Spanaway, 9 a.m. to 3 p.m. Directions: From I-5, exit 127 to SR-512 E; go about 2 miles to Parkland Exit. Turn right, go about 8 miles to 224th St. Turn left. Go 1 mile to 38th Ave. East; turn left. About 0.3 mile, signs on right. Talk-in on 147.38 PL 103.5, or simplex 147.500. Visit *[www.w7dk.org]*. for more info, or contact *Frank or Jill Palmer, 253-539-7772*. E-mail *[ac7jy@msn.com]*. Setup Friday 2 p.m. to 7:30 p.m. and Saturday 6 a.m. to 8:30 a.m. Admission is $5 with 16-year-olds and under free if accompanied by an adult. Plenty of free parking. RV parking available for self contained units only. VE exams will be held at 10 a.m.; contact *Shirley Murphy N7QHW, [sundancealso@harbornet.com]*. Tables available on site. Non-commercial tables $20 each, includes one admission. Commercial tables $30 each, includes one admission; helpers $5 each (limited).

AUG 22, 23

ALBUQUERQUE, NM The 2003 Duke City Hamfest will be held August 22-23 at the University of New Mexico Continuing Education Conference Center, 1634 University Blvd., NE, in Albuquerque. Talk-in on 145.33(-) (100 Hz) and 444.00(+) (100 Hz). RV parking ($10, dry camping only, no hookups). Tables $12 with no power and $18 with power. Doors open Friday 5 p.m. to 9 p.m., Saturday 7 a.m. to 3 p.m. Flea market, free tailgates, VE exams, forums. Free admission. Contact *Richie Allen KC5NZR, 1624 Columbia Dr. SE, Albuquerque NM 87106*. Phone *505-242-0208*, or E-mail *[kc5nzr@arrl.net]*. You can find more info on the Web site at *[www.qsl.net/dchf]*.

AUG 23

ST. CLOUD, MN The 57th St. Cloud ARC Hamfest will be held at the St. Cloud Armory on 8th St. North and 16th Ave., on August 23rd. Setup starts at 8 a.m. Doors open to the public 9 a.m. to 2 p.m. Talk-in is on 147.015 MHz; gabbing on 146.940 MHz. VE exams on site at 12 noon. Contact *Jack Maus WØMBD, 12647-210 St., Cold Spring MN 56320*. Phone *320-685-8295*, or call the radio club at *320-255-1410*.

AUG 30

UNIONTOWN, PA The Uniontown ARC will hold its 54th annual Gabfest on Saturday, August 30th at the club grounds located on Old Pittsburgh Rd. in Uniontown PA, just north of the intersection of US Rt. 119 and PA Rt. 51. Starts at 8 a.m. Free parking and free tailgating with registration. Talk-in on 147.045(+). Tables available. For info call Carl WA3HQK, or Joyce KA3CUT at 304-594-3779.

SEP 12, 13

BENTONVILLE, AR The B.C.R.O. Hamfest will be held at Thomas Jefferson School, 810 Bella Vista Rd., Bentonville AR, Saturday 8 a.m. to 1 p.m. Setup is Friday night at 6 p.m. VE exams at 10 a.m. Saturday. Talk-in on 145.290 down 600. Admission $3. Tables $5. Tickets are two for $5. Food and drinks available. Contact *Betty Weilberg at 417-435-2332* or by E-mail at *[jweiberg@leru.net];* call *Shirley Harris* at *479-451-8626;* E-mail *[saharris@centurytel.net];* or *Buster Morrow* at *479-631-9231*. E-mail *[ad5am@mc2k.com]*.

SEP 14

NEWTOWN, CT The Candlewood ARA of

Danbury CT will hold their Western CT Hamfest on Sunday, September 14th, at Edmond Town Hall. Directions: Rte. 6. Exit 10 off I-84. Follow the signs. Talk-in on 147.300(+) PL 100. New equipment dealers, flea market, tailgating, electronics, computers, refreshments. Tables $12.50 each (includes 1 admission). Tailgating $8 (includes 1 admission). Admission $5, children under 12-years-old admitted free. For reservations and info, contact *John M. Ahle W1JMA, 120 Fire Hill Rd., Ridgefield CT 06877.* Call *203-438-6782;* or E-mail to *[W1JMA@arrl.net].*

SOUTH DARTMOUTH, MA The Southeastern Massachusetts ARA, Inc. will hold its annual flea market on the club's grounds at 54 Donald Street in South Dartmouth. The event will run from 7 a.m. to 12 noon, rain or shine. Talk-in on 147.00/.60. Admission $2 (spouse and children free). Walk-in VE exams at 10 a.m. Free space and admission for vendors. For more info go to *[www.semara.org],* or contact *Tim Smith N1TI* at *508-758-3680.* E-mail to *[rt_smith@yahoo.com].*

SEP 20

ROLLING MEADOWS, IL The 51st Annual W9DXCC Convention and Banquet will be held Saturday, September 20th at the Holiday Inn (near O'Hare Airport) in Rolling Meadows IL. Come early. There will be a Friday Welcome Reception hosted by Carl Smith N4AA and DX Publications, followed by a Hospitality Suite late Friday. This will be hosted by the Northern Illinois DX Assn. Stay late on Saturday night and enjoy the Saturday Night Hospitality Suite hosted by the Greater Milwaukee DX Assn. Other features will include presentations by major DXpeditions, an ARRL forum, Grand Banquet and prizes, and DXCC QSL card checking. The Master of Ceremonies will be Jim O'Connell W9WU. For more info contact *Bill Smith W9VA* by calling *847-945-1564;* or E-mail to *[w9va@aol.com].*

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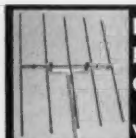

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SEP 25–28

SEATTLE WA Microwave Update 2003 organizers and the Pacific Northwest VHF Society are joining forces to host a joint conference in the Seattle WA area on September 25–28, 2003. Registrations for the joint conference will be accepted beginning April 1st. Cost of the registration will be $40 prior to September 12th, and covers all three days. Single day or single event registrations are not available. Late registrations, including at the door, will be $50. Registration forms can be downloaded at *[www.microwaveupdate.org]* or send an SASE to *John Price N7MWV, 12026 81st Ave. NE, Kirkland WA 98034,* and a form will be mailed to you. Completed registration forms and payment should be sent to the same address. Make checks payable to *Microwave Update 2003.* Joint conference sessions and the Saturday evening banquet will be held at the Everett Holiday Inn and Conference Center, a short drive north of downtown Seattle. Special rates have been arranged with the hotel for conference participants. Rooms are $69 per night plus tax, a real bargain for the Seattle area! It is suggested that early reservations be made directly with the hotel at *425-337-2900.* Be sure to mention "Microwave Update" to get this rate. Reservations must be made by August 21st for this rate.

"White papers" are currently being solicited from potential authors and speakers for publication in the 2003 conference proceedings. Topics specifically of interest to Microwave Update attendees, as well as those on VHF and UHF subjects usually associated with the annual Pacific Northwest VHF Conference are being solicited. Papers will be accepted until July 1st, 2003, to allow enough time for printing. White papers should be sent directly to *Jim Christiansen K7ND,* via E-mail at *[k7nd@att.net].* MS Word format is preferred. Microwave Update 2003 and the Pacific Northwest VHF Society respectively, will be the sole judges of whether presentation requests and white papers are accepted.

If you are interested in making a session presentation at one of the Microwave Update 2003 sessions, please respond to *NU7Z [nu7z@aol.com].* For presentations at the Pacific Northwest VHF Conference sessions, contact *N7CFO* at *[n7cfo@ix.netcom.com].* LCD projection equipment will be available for those using PowerPoint presentations. Slides and video presentations can be accommodated with advance notice.

SPECIAL EVENTS, ETC.

AUG 16, 17, 18

NEW JERSEY QSO PARTY The Englewood Amateur Radio Assn., Inc. invites all amateurs the world over to take part in the 44th Annual New Jersey QSO Party. (1) The time of the contest is from 2000 UTC Saturday, August 16th to 0700 UTC Sunday, August 17th and from 1300 UTC Sunday, August 17th to 0200 UTC Monday August 18th. (2) Phone and CW are considered the same contest. A station may be contacted once on each band — phone and CW are considered separate bands. CW contacts may not be made in phone band segments. NJ stations may work other NJ stations. (3) General call is "CQ New Jersey" or "CQ NJ". New Jersey stations are requested to identify themselves by signing "De NJ" on CW and "New Jersey calling" on phone. Suggested frequencies are 1810, 3535, 3950, 7035, 7235, 14035, 14285, 21100, 21355, 28100, 287400, 50–50.5, and 144–146. Suggest phone activity on the even hours with 15/10 meters on the odd hours (1500 to 2100 UTC); 160 meters at 0500 UTC. (4) Exchange consists of QSO number and QTH (state/province or country). NJ stations will send county for their QTH. (5) Scoring: Out-of-state stations multiply number of complete contacts with NJ stations times 3 points per QSO times the number of NJ counties worked (maximum of 21). NJ stations multiply number of complete contacts times 3 points per QSO times the multiplier. The multiplier is the sum of the number of states (other than NJ), Canadian provinces, and NJ counties worked. Maximum is 49 + 13 + 21 = 83. (6) Certificates will be awarded to the first place station in each NJ county, state, province, and country. In addition, a second place certificate will be awarded when four or more logs are received. A total of two plaques have been donated by the ARRL Section Managers for NNJ and SNJ to the highest scoring single operator station residing in each of their sections. (7) Logs must also show the UTC date and time, QSO exchange, band, and emission, and be received no later than September 13th, 2003. The first contact for each claimed multiplier must be indicated and numbered and a check list of contacts and multipliers should be included. Multi-operator stations should be noted and calls of participating operators listed. Logs and comments should be sent to *Englewood Amateur Radio Assn., Inc., P.O. Box 528, Englewood NJ 07631-0528.* A #10 size SASE should be included for results. (8) Stations planning active participation in New Jersey are requested to advise EARA by August 1st of your intentions so that they may plan for full coverage from all counties. Portable and mobile operation is encouraged.

SEP 27

RAYMOND, ME The U.S. Coast Guard Auxiliary D1NR Radio Raymond, K1G. 1300Z–2100Z Sep. 27th. 64th USCG Auxiliary, 25th Canadian CG Auxiliary anniversaries and ISAR Special Event Radio Day (VO1RAC). 28.320, 21.310, 14.260, 7.260. CGA Certificate. Contact *Keith C. Morton W1NDH, P.O. Box 809, Raymond ME 04071-0809.* 73

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Construction of a 47 GHz Transceiver and Other Junk Box Considerations

Well, here we are, and I never thought I would be talking about working at 47 GHz using some sophisticated junk box parts. However, surplus material is being made available and with a diligent search of surplus outlets you can also obtain components that can be assembled into an effort making construction possible.

It was not an overnight collection binge that put this effort forward, but rather a slow process aimed in this direction. Collecting material for a planned project does take time, especially when you are not ready to sell the family farm for parts needed. Some of the material can be obtained in nearly ready made kits with only one problem — they are costly.

I chose another avenue and that was to sit and wait like a spider in a net for the parts to come my way. Whatever method for collection, time is on your side. If you will allow time to collect surplus bargains you too can put an inexpensive transceiver converter together. All you need is some luck to locate key parts and the time to find the inexpensive components needed. Take, for example, my first SSB transceiver for 10 GHz.

In construction of the SSB rig, I should have revamped circuitry to make it more reliable by manufacturing PC boards used for control and switching; instead of the dead bug–type construction I used back some 10 years ago. Even so, this rig has stood the test of time.

For example, when I mounted the 10 GHz rig in my grandson's tree fort in the back yard, the kids filled my outdoor compartment with about 25 pounds of sand. Needless to say, some shaking out was needed and I thought it was a goner. Took a while to dump all the sand and vacuum it out but it's still working just fine now — with a lock on the transit case.

This little episode demonstrated certain reliability in construction even back then in my early years of putting surplus parts together. I still can imagine the effort it took to haul all that sand up into the tree fort and dump it carefully into the muffin fan exhaust hole. There still is sand embedded in the RTV used to harden the circuit boards. Using the RTV like a potting compound to protect the wiring and parts has worked well over time.

The rig is switched by 4 SMA relays controlling a TWT (Traveling Wave Tube) 10 watt amplifier and a series of 2 RF preamps. The unit was a collection of quite

Photo A. *Front view of synth top right, sitting on top of BCD controller chassis. Synth capable of operation from 8930 to 10730 MHz with +14 dBm output. Frequency steps as fine as 1 kHz throughout its frequency range set by BCD switches on control panel. Close in phase noise better than -90 dB.*

Photo B. *Top view of total system main synth to right, 2640 MHz synth bottom left in aluminum cutout shield compartment. Pecom TX module just above 2640 MHz synth. Switching regulated power supply to far left with cooling fan in front of power supply.*

a bit of equipment all assembled over time, and is still running just fine, knock on wood. On the other hand, the setup of establishing a station on 24 GHz was easy, as my confidence and shaky hand and eyesight were not that of my younger years, and I put that project off till a completed transceiver made its way into my hands.

In other words, I paid my way into this rig for 24 GHz. It was a Pecom transceiver modified by Sam Lutweiler K6VLM of the San Bernardino Microwave Society (SBMS).

Large quantities of these transceivers were obtained in a group bulk purchase of these surplus Pecom transceivers. The types we obtained were what we call high-side injection and low-side injection. The low-side injection had a frequency of operation of 23.xxx GHz for transmit and received in the 22 GHz range. For high-side injection the TX and RX frequencies are just reversed to make a full duplex pair.

Of primarily interest was the construction of a 24 GHz rig from Pecom Surplus. Sam K6VLM, who became a silent key, accomplished this effort with great results. In the meantime, Kerry N6IZW also was working out the conversion of the Pecom modules for a 24 GHz transceiver from his original tests and some of Sam's notes. Lots of other ideas have sprouted for these modules and are being worked on by many other individuals. This project is still ongoing.

Kerry N6IZW, who has modified several modules, observed the relationship of the frequencies used in the unmodified 23 GHz transmit module. While in its original configuration — it was driven by a 9 GHz LO and had an IF frequency of nearly 3 GHz — it presented some interesting possibilities for use on 47 GHz. With a 10 GHz LO drive which is doubled in the Pecom TX module mixer, and IF drive in the 2.640 GHz produces a RF output in the 23.5 GHz range. This method allows the Pecom TX module to operate nearly stock, driving a final output mixer doubling the drive (23.525 GHz x 2 = 47.05 GHz).

A little figuring revealed that by using components on hand, the following could be constructed and given a try. Working backwards, if we used 47.05 GHz for an LO divided by 2 = 23.525 GHz (the Pecom TX unit driver output). Now we had 2.640 GHz synths on hand and used one for the IF input driver on the Pecom TX converter. That meant that 23.525 GHz the TX output minus 2.640 GHz = 20.885 GHz, which is the twice the input drive LO to the TX module. Dividing that by 2 = 10.44250 GHz.

Now for other than power supplies, dish antenna, synthesizer, or source of a local oscillator and a mixer for 47 GHz, this rig could be constructed with the major item being the TX module from the 23 GHz Pecom transmitter. These Pecom units have been made available for about $20 to $50, depending who has them and their condition.

Using an agile synthesizer that can be set up in 1 kHz steps made the main LO task simple. A Frequency West brick or other LO could be used here. We used the Agile Synthesizer as it was in our junk box and it operated from 8930 MHz to 10700 MHz — just right for the required 1044250 MHz LO drive. Using with the Qualcomm 2640 MHz synthesizer (Pecom IF in/out) gave an output at 23.525 GHz, right in the normal operation range of the TX module. With 100 mW (+20 dBm) drive (Pecom output) at 23.525 GHz to inject into the LO port of a home-built mixer constructed from 2 anti-parallel diodes (LO doubler), we got 47.05 GHz, 50 MHz up from the bottom of the band.

Using a 145 MHz multimode transceiver as the IF RX/TX source produced an operational frequency of 47.195 GHz. The 2-meter transceiver was set to 250 mW output, 1/4 of a watt. An 8 dB attenuator was attached between the transceiver and the microwave mixer. This reduced the transmit power to +7 dBm output drive to the IF mixer port. Total mixer power being used was the LO at +20 dBm; IF drive on transmit of +7 dBm seemed a little high but we went for the gusto and it seemed on test to function very well. Besides, we had replacement diodes in the way of PC boards from Qualcomm Surplus to obtain new mixer diodes should that be needed.

A trial at Kerry N6IZW's QTH during the San Diego Microwave Group's monthly meeting was our show-and-tell portion of the system check. It was a go for the gold effort without system checkout.

First test on the workbench at 2 feet showed initially something was very wrong — we were receiving signals every 25 kHz up and down the band. Checking with the spectrum analyzer, it was traced to my 2 GHz synthesizer DC power supply 10-volt line. It seems that the 7812 12-volt voltage regulator was oscillating and needed better filter cap action. Replacing the 10 µF bypass cap with a 100 µF cap removed the offending ripple on the DC feed and cleaned up the synthesizer output greatly. Testing the transverter over this 3 foot path proved simple and produced a great note for CW near as good as you could get. For a simple test we tried SSB on Kerry's 2-meter multimode IF driver. I switched to SSB on my Yaesu FT-817 and clarity was just as good as 40 meters during the best of times.

Wow! This was a contact on 47 GHz and what fun this was! It was like putting your first crystal detector set together. Just for additional fun we decided to increase distance as we were using AC power supplies for the rigs. We patched in a seventy-five foot extension cord and walked out of the garage and down the driveway, still operating SSB between Kerry N6IZW and myself, WB6IGP.

What fun. Signal levels were in the S8+ region still. Moving the 10 GHz synthesizer 10 kHz in frequency (it's multiplied by 4 in the rig) moved the IF frequency 40 kHz as expected. Also trying later that evening

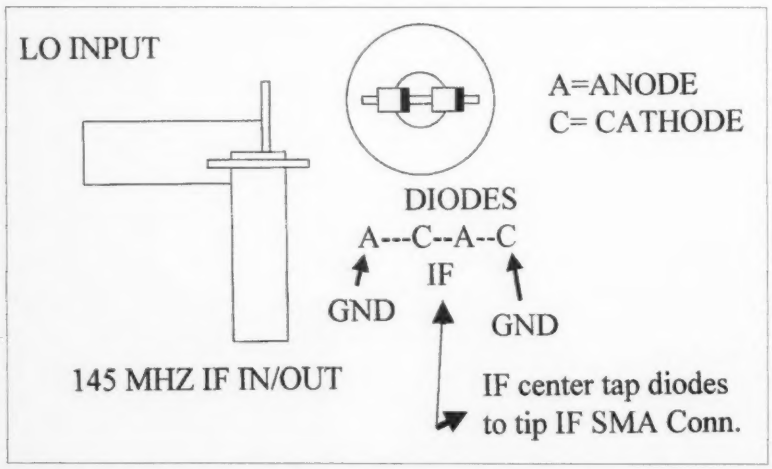

Fig. 1. Showing mixer construction/placement of microwave diodes on back of SMA bulkhead connector. Use shortest possible lengths. Used bare mixer for demo on 47 GHz for short SSB contact at club meeting SDMG San Diego Microwave Group.

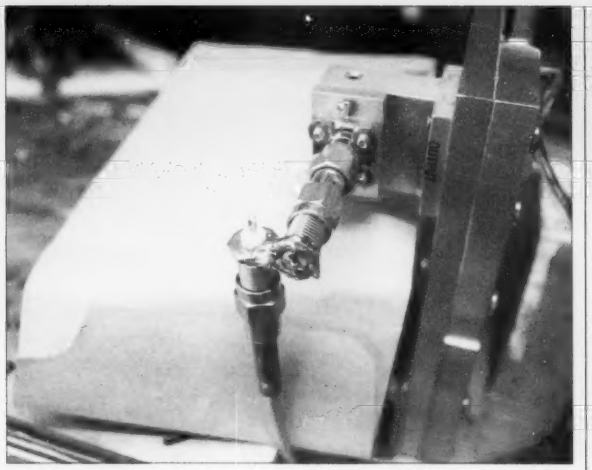

Photo C. *Close-in shot of system mixer showing fly spec diodes and IF cable (145 MHz) and SMA connector pointing downward in this test configuration.*

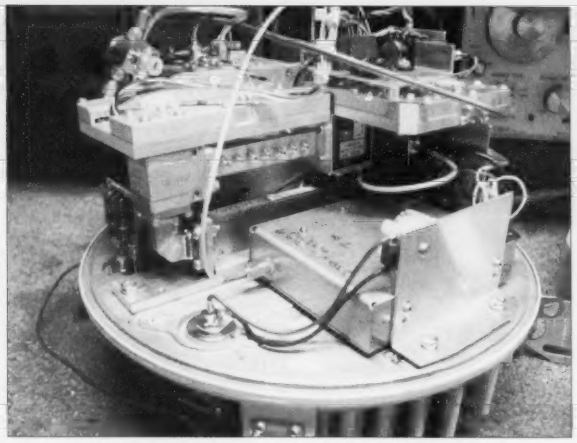

Photo D. *Side view of complete modified Pecom 24 GHz rig completed by Sam K6VLM. Center is same TX module used in 47 GHz rig. Module behind TX unit on multi screw aligned filter is receiver module.*

after Kerry placed a 40 GHz waveguide in the system to ensure it was not 23 GHz overload of the receive mixer and signals were still functional, proving to our satisfaction we really were on 47 GHz. After all, we had to use these procedures as we did not have 47 GHz test equipment, and an alternate method had to be used to demonstrate what was going on.

Now several things we used to assemble this surplus material making this transceiver possible. It took time and effort but was assembled all in surplus and is a demonstration to show others a possible road to follow.

There remain several issues, those being small dish antennas to be added to the system allowing greater operating range. DC power supplies make the rigs portable. The AC switching power supplies were used initially because they supplied plus five, in addition to plus 15 volts that were adjusted to 5.2 volts and 15.6 volts on the +15 volt supply for the YIG synthesizer requirements.

A bank of voltage regulators for minus 5 volts, and plus 10 and 12 volts DC for other circuit requirements, came off of the switching power supplies' plus and minus 15 volt output taps. A little crazy to use a switching power supply capable of 40 amps at 5 volts, but robust for our power needs and it was in the junk box.

This multi voltage output power supply made the power supply issue only a matter of connectors and a slight voltage re-adjustment to increase the 5 and 15 volt lines up a few tenths of a volt for synthesizer requirements. Other changes might be to remove the synthesizer control BCD switch box and hardwire the YIG synthesizer control circuitry and greatly reduce the size of the rig. Lots of possibilities. After all, there are still new junk boxes to look in and we just might find what we are looking for if we sit back and wait for that item to land in our spider's web.

The power supply, like most other items, was obtained in surplus from a local scrap metal junkyard. The Pecom transceiver was obtained surplus for $20 from another scrap metal yard in the Sunnyvale CA area. The synthesizer was obtained in surplus, a find I am still amazed about; I feel very lucky we were able to obtain it for our microwave group. It was a chance thing alerting me to the frequency agile synthesizer, and we jumped on them like an ant into a jar of honey. Like all items rare, it was one of several key items used in the construction of the converter for 47 GHz.

In the picture is the synthesizer sitting on top of the BCD switch controller for the parallel input control to the synthesizer programming data lines. Inside the controller is an external 10 MHz OCXO reference oscillator. Just by the muffin fan on the bottom left is the Qualcomm DRO synthesizer set to a fixed 2640 MHz. The module standing on edge is the Pecom TX transverter to 23 GHz. The part of this system that is home-built is the 47 GHz mixer.

The mixer consists of two SMA bulkhead coax connectors, one modified to accept two microwave diodes on its back face and the other to serve as 145 MHz IF port. The diodes used were scrap from Qualcomm transceivers for 14 GHz obtained locally. Application of a heat gun removed the diodes from the original PC board, a 14 GHz mixer. Their quality seems unsurpassed and they showed great millimeter frequency applications — especially considering the cost. Like all of the other material we picked up for this project, the diodes for the mixer also proved to be surplus material. I have to admit that I purchased new the two SMA connectors used for the mixer.

Mixer modification

The bulkhead SMA connector Teflon is cut off flush with the back of the SMA flange. Also, the center conductor of the SMA connector is cut off nearly flush with the back of the connector. Next, a second SMA connector is soldered to the first connector to make the structure rigid. Use 0.141 hard-line to support both connectors and form the mixer towards the focus point of a small dish. The mixer is not difficult to construct.

Two diodes are required. One diode is soldered one end to ground and the other end to the nub of the center conductor of the SMA connector centered about a straight line from 9 o'clock to the center pin (anode to ground, cathode to the center pin). The second diode is soldered anode to center pin in line from center pin to 3 o'clock and cathode grounded. Leads are kept as short as possible with the diode laying flat against the flange back of the SMA connector.

Testing to see if the diodes survived the handling and soldering, measure with a VOM on diode check or use the x10 scale of a VOM. Measure from center pin to ground and you should see a diode junction forward resistance. Reverse the meter

Continued on page 59

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Houston TX 77083-5640

Inventory Time

As with those who monitor the stock market, it's time to take stock of our hamsat assets.

We have lost some valuable resources in 2003. A number of amateur satellites have gone silent, the digital hamsat population is at a low not seen in over a decade, and the ranks of the analog voice satellites have been diminished. It's time to get back to our "core business," chasing satellites while we have them.

Too many hams are surfing the Internet or turning into couch potatoes, watching the hundreds of available TV channels offered by cable, and other providers, like DirecTV and the Dish Network. The utility of cell phones has logically eclipsed repeater systems with phone patches, but amateur radio satellites remain as a viable communications medium for those who prefer personal, direct communications, with a touch of homegrown high tech.

What's up?

Did you know that OSCAR-3 is still in orbit? That's right. Unlike OSCAR-1 and OSCAR-2, which were placed in very low orbits back in the early 1960s with their military primary payloads, OSCAR-3 has one of those extremely long-life orbits that will outlast us all. The bad news is that OSCAR-3 can never come back on-line for ham use. It is history. It's gone. It's a silent piece of space junk in the sky.

In 2003, other hamsats have joined it. Fuji-OSCAR-20 and Fuji-OSCAR-29 have become erratic. It's news just to hear that either has been heard on a random orbit. AMRAD-OSCAR-27 has had problems that sound like the end is near. KITSAT-OSCAR-25 is presumed dead and UoSAT-OSCAR-22 may only come back for short periods. They are no longer providing reliable digital service.

Tough times. Is there any light at the end of the orbit? Yes, but this is a job for optimists. The pessimists have already bailed out.

The voice and CW hamsats

The most popular satellites today are the single-channel, cross-band, FM hamsats. All of them use a Mode "J" configuration — two meters up and 70-cm down. UoSAT-OSCAR-14 (UO-14) is the favorite. When the 9600-baud digital store-and-forward system failed a few years ago, this long-life offering from the folks at the University of Surrey in England was retired to a less demanding activity as a simple FM-voice repeater in the ham bands. It is always active and can be worked with a dual-band HT using only a whip antenna. Hand-held dual-band yagis have provided solid contacts for users in remote locations from the back-country of Alaska to cruise ships. Contacts are usually very short due to the large numbers of users on any given pass.

Other FM satellites include AMRAD-OSCAR-27 (AO-27) and SaudiSat-OSCAR-50 (SO-50). AO-27 has been available in North America for FM voice use on occasional weekend morning passes, but SO-50 has been active whenever a control station has been available to turn the satellite on. SaudiSat-OSCAR-41 is also capable of use as an FM repeater, but has not been heard since SO-50 was launched. Both AO-27 and the SaudiSats are more difficult to use than UO-14. They are best worked from home stations with yagi antennas.

Although it's not a ham-radio satellite, the International Space Station finds its place in the FM resource list. Even with limited operations onboard the ISS, the possibility of some voice ham activity from the two-man crew for random contacts exists. Scheduled QSOs with schools continue, thus keeping hams optimistic that a good voice contact might happen.

The most exciting voice satellite has been AMSAT-OSCAR-40 (AO-40). Although there are a number of systems that no longer function since the onboard "event" (explosion?) shortly after launch, it has provided global communications and extraordinary DX opportunities using relatively small ground-based antenna systems. The transponder incorporates a 23-cm and 70-cm uplink that converts to a downlink on 13 cm. FM is not supported, so SSB or CW must be used for communications.

The orbit is highly elliptical and the passband is wide, supporting many simultaneous contacts. It's like having a new ham band available for use almost every time the satellite comes above the horizon. Working 100 countries via AO-40 isn't easy, but it has been done several times. Many DXpeditions have taken equipment along just to make contacts via AO-40. Inexpensive 13-cm antennas and downconverters have made the microwave downlink accessible to anyone with even a small budget for satellite operations.

For the "techies," AO-40 also offers a 24 GHz downlink. Very few stations have successfully received signals from this transmitter, but it is a challenge worth pursuing. Some receivers and transmitters on AO-40 may still be usable beyond those mentioned, but it is highly unlikely that we will ever hear anything on two meters or 70 cm.

All of the other active analog satellites are having problems. The high-orbit AMSAT-OSCAR-10 (AO-10) has been locked into Mode "B" (70-cm up and two meters down) for many years since radiation damage took out the onboard computer system. There have been no reports of usable signals via this satellite since last year.

The Japanese hamsats, Fuji-OSCAR-20 and Fuji-OSCAR-29 are now rarely heard. The batteries on both satellites are failing and ground stations are having difficulty keeping either bird on the air. The Russian RS-15 is very difficult to work, even when it's active. The best low-earth-orbit analog

(non-FM) satellite in the sky is currently AMSAT-OSCAR-7 (AO-7)! After almost two decades of silence this satellite came back to life in late June, 2002. The batteries are dead, but whenever AO-7 enters sunlight, the circuits come alive thanks to power directly from the solar panels. The satellite has two transponders, Mode "A" (two meters up and 10 meters down) and Mode "B". Operators have to be ready for both, since either might be turned on randomly when AO-7 wakes up in the sun. Although the satellite will respond to ground commands, it is easier to just let AO-7 carry on "as is."

Digital satellites

Once we had three reliable 9600-baud digisats, including UoSAT-OSCAR-22 (UO-22), KITSAT-OSCAR-23 (KO-23) and KITSAT-OSCAR- 25 (KO-25). Now we have none. UO-22 recently developed battery problems that have precluded reliable operation, while both KITSATs failed some time ago.

It is actually easier to list the few functional digital hamsats than to enumerate the ones that have recently gone off-line. Two popular digital systems are those on the ISS using standard AX.25 packet with the callsign RS0ISS-1, and Nav-OSCAR- 44 (NO-44) — otherwise known as PCSat. The ISS packet system may have problems, since it has not been heard for some time.

PCSat was built by midshipmen from the U.S. Naval Academy in Maryland and is primarily a 1200-baud APRS (Automatic Packet Reporting System) digipeater. Even though there are serious problems with the power system, Bob Bruninga WB4APR, has coaxed the satellite along far past its anticipated life.

An overlooked current digisat is MO-46, known as Tiungsat-1 from Malaysia. It offers FM and FSK (Frequency Shift Keying) amateur communications at 38,400 baud. Few stations have made the leap to the higher-speed data rate. This speed may just be the beginning though, since megabit rates are in the works for future digisats.

AO-40 also has digital equipment onboard. In addition to the telemetry downlink, there is RUDAK. RUDAK stands for Regenerativer Umsetzer fur Digitale Amateur-Kommunikation (Regenerating Transponder for Digital Amateur Communications). But as implemented in AO-40 it is much more than a regenerating repeater. It is a pair of fully programmable computers, each of which has its own error corrected memory and associated hardware modems and DSP modems. It also controls many of the experiments on AO-40, including the GPS, the SCOPE cameras, two sets of temperature telemetry nodes, the MONITOR HF passive sounding experiment, and the CEDEX radiation experiment.

Looking toward the future

Even with all of the recent losses, we still have many operational hamsats in orbit. If you were to gear up for them all, it would be a full-time job. Unlike AO-7, most satellites never come back after going silent. Batteries are the most common culprit, but other failures can also occur. Go to the AMSAT Web site [http://www.amsat.org] and check out the frequencies, statistics, and schedules for the satellites we have today, and use them.

For the future we have Project Echo from AMSAT-NA (North America), Phase 3E from AMSAT-DL (Germany), PCSat-2 from the Naval Academy, and many other small satellite experiments thanks to various universities around the world. There are also occasional surprises like the SaudiSats, the return of AO-7, and satellite projects that seem to happen "under the radar." VUSAT from India could be one, while other projects in France, Russia, and additional countries could show up when least expected. Stay tuned and keep your eyes on the sky. 73

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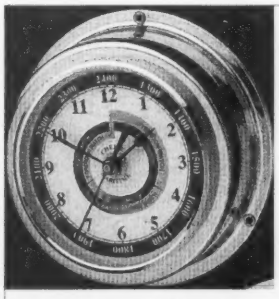

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Mounting an Iron Horse

Does the XYL roll her eyes when she sees your car? If not, you obviously don't have enough antennas! Here's the latest on the KE8YN/7 mobile antenna farm.

For those who might not have seen the last column or two, I recently installed an Alinco DX-70T radio in my vintage Ford Taurus. I had been operating 2 meters with APRS and 440 MHz, but I missed having the ability to work outside the coverage of the local repeaters. In Wyoming there is good repeater coverage, but there are also a lot of wide open spaces, so it seems a natural place to concentrate on the high frequency bands.

Initially I used a trunk lip–mounted multiband antenna, but I wanted to get better performance, and that naturally called for a larger antenna. I settled on the Iron Horse HF antenna line, and decided to concentrate on 6, 10, 20, and 75 meters. Six meters is kind of a bonus on the DX-70, since it really is a VHF frequency and there is a separate antenna connection for a six-meter antenna. If you use a multiband antenna you can use a duplexer to separate the coax into two separate connections, but by using the individual antennas for each band, this was not an issue. Whatever direction I took to mount my antenna I would need to do twice — once for the lower bands and a second time for six meters.

The six-meter antenna is shorter than the others, measuring about 50 inches tall. I briefly played with the idea of mounting it with a magnet mount. The Taurus has many parts made of alloys and/or plastics, including the trunk lid. As such, the only viable place for the antenna would be on the roof. I could see a tree limb or Wyoming's famous wind knocking the antenna off the roof very quickly, so I decided against that option.

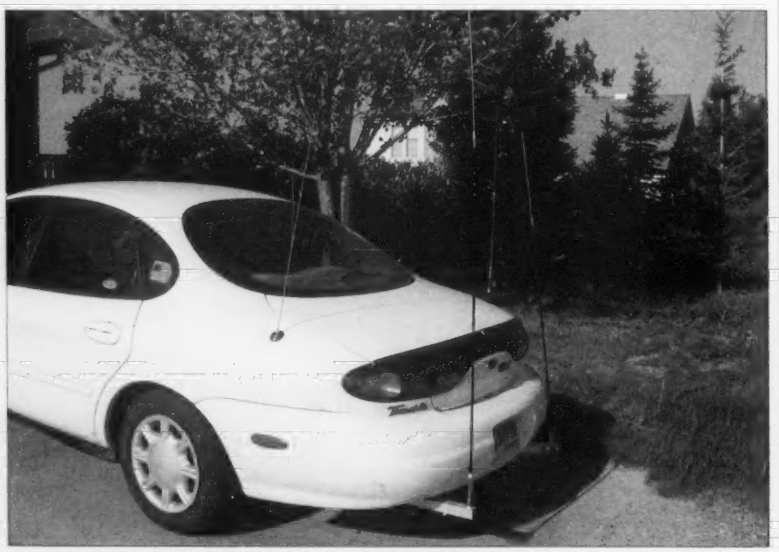

Photo A. *Fashion experts say that the multiple antenna look is "in" this year. Besides the 2-meter/440-MHz antennas glass-mounted and on the trunk, there's an Iron Horse 6-meter antenna on the right and a matching 20-meter antenna on the left.*

I crawled under the rear of the car several times trying to come up with a suitable idea. The rear bumper is plastic. I assume there is some metal located inside the plastic bumper shell, but without disassembling it I never found where that metal might be. I do know after lying on the ground under the car that the backside (well, the part closest to the front of the car but hidden from view) has blocks of Styrofoam inside the plastic shell. In any case, the bumper offered no opportunity that I could see.

I looked through the various radio catalogs and on-line for a suitable antenna mount, without any luck. In my effort to pursue every route of research, I made a trip to the nearest truck stop and looked through the CB radio selection. I figured that most trucks have a significant amount of fiberglass to save on weight, so truckers would have similar issues. Nothing appeared to be a perfect solution. Most truck antenna mounts are designed to attach to the rear-view mirror mount, so most were designed to clamp to a tubular structure.

One possibility had the 3/8-inch 24 mount attached to a 6-inch piece of 1/4-inch aluminum bar stock. There was a mounting bolt through a 3/8-inch hole at the other end of the aluminum bar. The Taurus has two steel fixtures at the rear of the body that are designed to accept the tire jack for a roadside tire change. Although I really didn't want to obstruct the jack mount, I thought of several things. First, in the event of a flat tire, I expect to call the auto club — and they use a real jack rather than the one stowed in the trunk. Second, I have no desire to ride around on the undersize mini-spare that is in my trunk. Third, communications are more important to me than a "Plan B" for a flat tire.

I crawled under the car with the antenna mount — and naturally it was far too short. However the basic concept looked like it

would work. I measured the distance from the jack mount to the edge of the bumper and thought that 9 inches would suffice. I failed to include the fact that the curvature of the bumper would require a few more inches. I'll save you the gory details, but ultimately the length of the antenna mount turned out to be 12 inches.

I checked out my local home improvement store to see what type of bar stock they might have available. There was a selection of angle iron, iron bar and aluminum, but most was thinner than I would have liked. A large antenna, after all, can function much like a large lever and I didn't want my mount to produce a 6 foot curb feeler dragging behind the car. I decided on aluminum angle stock that measured about 1-1/4" per side. The angle stock was about half the thickness of the original bar stock that I was seeking. I believed that while the horizontal piece of the angle would give me a place to mount the antenna and connect to the car, the vertical segment would provide greater strength. Eventually I decided to take two pieces of the aluminum and build an inverted "U"-shaped channel. This would give me a double thickness to mount the hardware, with a vertical piece on either side.

While I have a reasonable selection of hand tools, I knew this would be easier to complete with a little more horsepower. The home improvement store had the usual selection of high-quality, heavy-duty tools, but also had some items designed for those of us with an occasional need. I found a small drill press for just under $40 that made the job significantly easier.

I drilled a 1/2-inch hole one inch from each end of the aluminum. When I drilled the first hole, I used it to mark the second one so that everything lined up. The 3/8-inch 24 mount requires a 1/2-inch hole to accommodate the nylon insulator. I decided to use the same size for mounting the bracket to the car using a 1/2-inch bolt, with a large flat washer above the hole in the jack stand bracket and a lockwasher and nut below. Incidentally, the jack stand brackets are not precisely installed, so you may need to shim the bracket slightly to have a perfectly vertical antenna.

After mounting a bracket to each of the rear jack stand brackets, I ran coax from the antenna mount through a hole in the bottom of the trunk. Usually there are some openings that have rubber plugs installed by the manufacturer. I removed the plug, routed the wires and cut a slit into the plug so that I could replace it around the coax. This grommet will help to prevent the coax from rubbing against the metal of the car body and shorting. I then routed the coax along the plastic trim below the doors to the front of the car. Add some coax seal to the connection between the antenna mount and the cable and you're pretty well done. There are all kinds of opinions about how, or even whether, coax connections should be finished, but I've generally had good luck with the putty-like tape that is wrapped around the connection then blended into a single layer with the fingers.

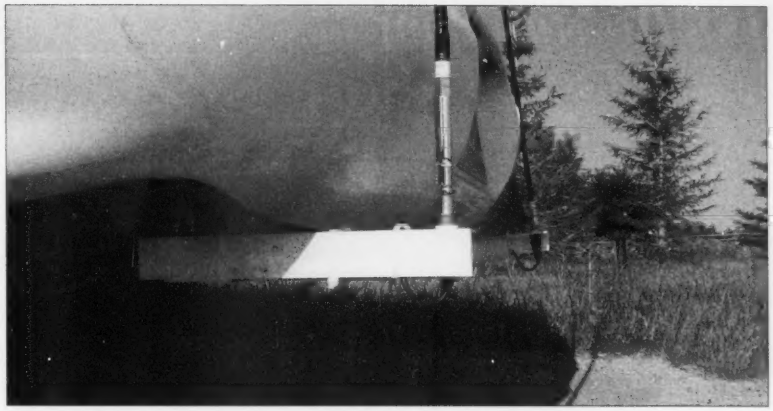

Photo B. *When faced with a tall antenna and a plastic bumper, one option is to construct an extension that mounts to the automobile frame and extends just beyond the bumper. The extension here is mounted to the support normally used to connect to the jack used to change tires. The cable ties keep the coax in place.*

Incidentally, I normally make my own cables and try to stock up on PL-259s and adapters whenever I hit a hamfest. I had not been to a hamfest in a while and stopped by the local Radio Shack to pick up the supplies. Surprisingly it was cheaper to purchase manufactured 20-foot RG-58 cables than to purchase the individual components.

I had already decided where I wanted to operate on each band. The six- and ten-meter antennas cover a fairly wide bandwidth, so that was no problem. Twenty meters is a little more challenging because I prefer to operate in the lower segment of the band to cover the advanced and extra segments (14.150–14.225 MHz), but I also need coverage for the MARS frequencies, which are above the top of the ham segment of the band.

I assembled the antennas, which involves adding the stainless steel whip onto the fiberglass base that includes the coil. I prefer to use the quick disconnects that Iron Horse sells for two good reasons. First, there is the obvious ability to quickly switch antennas. Second, by using the quick disconnects, there is very little change in the SWR if you switch the antenna to another vehicle.

I set the radio to the center of the segment of each band where I wished to operate, listened to make sure no one was on frequency, set the radio to low power, and checked the SWR. On each band I was able to tune the antenna so that the needle barely moved when I measured the reflected signal. Iron Horse recommends that you trim the unused portion of the whip rather than leave it inside the fiberglass base, so I cut the excess, and tightened the hex screws and the ferrule that connects the whip to the base. I like things easy, painless, and ready to operate.

The Iron Horse HF antennas are, in my book, serious antennas that don't cost an arm and a leg. They can handle up to 250 watts and provide a reasonable band segment on all the popular bands. They are tall enough that there is a reasonable amount of metal in the air to get a good signal. The 20-meter antenna is just under 100 inches tall. With my antenna bracket 2 feet from the ground, this presents almost 10 feet above the ground. The other antennas are comparable, with the exception of the six-meter antenna. The six-meter antenna is low enough that I leave it on all the time. I do remove the HF antenna for garage parking, but with the quick disconnect, I can have it on the car and be in the driver's seat operating within 60 seconds.

Given how band conditions change and the performance of an antenna is impacted by surrounding terrain, it is always difficult to compare one mobile antenna to another. However, so far I am getting excellent signal reports, and significantly better than I did with my multiband. That's enough to make my mobile operating fun, and that was what I was trying to accomplish. 73

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100 WPM and a Blown Mind

If your typing skills are anything like mine, PSK63 will truly blow your mind. I mean, it is visibly twice the speed of PSK31. The claim is 100 words per minute. I admit that is way faster than I can rattle the keys.

I had read a bit of discussion about the mode and took a look to see what the excitement was about. There was a rumor that Dave AA6YQ had incorporated it into his WinWarbler, so I looked there first. Best I could see, he was promising a release in "the near future," and it has already arrived, even as I write.

However, the best part was Dave published instructions on his Web site, to set up the new mode in conjunction with regular WinPSK. I printed those instructions, followed them, and it worked perfectly. I came up with two icons on the desktop, one for PSK31 and the other for PSK63. Both use the WinPSK format, which involved rebooting the program to change modes.

This shutdown and reboot is a quick operation, and you discover quickly that you will stick with one or the other modes long enough that mode switching is not really an inconvenience. It didn't take long for this switching arrangement to become a thing of the past, as other programs incorporated the mode.

The scene changes

As soon as I had made the above setup and made my first PSK63 contact, the developments started surfacing rapidly. Within a day or two, the MixW2.08 became available with this mode as a standard feature.

I installed the new version and wrote the simple macro to invoke the PSK63 mode and lie in wait around the 14.073 area and got a first contact with that software. The interesting part was that the other ham was using the WinWarbler package, which also had the new capability.

So, here were three programs suddenly available to work this exciting new superfast mode. There is an advantage to both the WinPSK and the WinWarbler — They are FREEware. That is a hard-to-beat price.

The WinWarbler has an excellent right-out-of-the-box feature incorporated in the front panel that allows a quick click to choose between PSK63, PSK31, and RTTY. Very quick and easy, no macros to write.

I noticed as I used the MixW2.08 that, when the PSK63 mode was invoked by use of the macro, the mode in the built-in log reads BPSK63, so that part is fully automated. These ham programmers think of everything.

You may feel intimidated by the high speed capabilities, but you are not alone. Very few hams type at anywhere near the 100 word per minute capacity offered by this mode. However, there are some real advantages when you compare this to our regular speed modes and even RTTY, which is quite quick in its own right.

PSK31 could become a great quick turnaround contest mode, and that is hardly a far-fetched opinion. I think the avid contest folk are already considering it, from some comments I have seen.

There is more when you consider all the time wasted with the average brag-file. By comparison, when I first got the WinPSK combo up and running, I spent some time calling CQ and made timed runs on the CQ macro pitting PSK31 against PSK63. It should not have surprised me, but it did. The old, slow PSK31 took 30 seconds to run the macro. The same macro in PSK63 took just 15 seconds. I would say that is a scientific enough experiment to declare the speed is, as advertised, twice as fast.

Think about it. We could, just to cover up our typing inadequacies, start using even more macros and getting everything said before the path disappears. I did notice there was far less time to type ahead, which is my approach to holding up my end, while the other ham is sending his message. Ordinarily, I can have most of my thoughts in the buffer by the time the other ham turns it back to me, but that certainly has not been the case thus far with PSK63. I may be busily typing ahead and have 10 or 15 words typed in and suddenly realize he is waiting for me to transmit. I need to make an adjustment to my brain speed. Even my macros seem to have grown shorter.

PSK63 development credit has to go to Skip KH6TY. I heard him several times in the past few days, but have not had a chance to work him. Propagation has its ups and downs, but I am sure that as active as he is with his new brainchild, it won't be long before we meet over the air.

Skip is certainly no newcomer to digital innovation. If you take a look at the DigiPan credits, you will find he is one of the contributors to that fine piece of software as well. I often recommend DigiPan as a first go at digital ham software for newcomers. And I find a lot of hams, once accustomed to DigiPan, simply stick with it. Something to do with the don't fix what ain't broken philosophy.

You gotta try it

With two freebie choices plus the availability in MixW (which has a small price tag), the PSK63 is quick and easy to get, install and get it on the air. I don't think I spent 15 minutes getting any of these three programs installed and ready to play, and they are all excellent. It is always fun to play with a new toy and this one is just that, a really fun new toy.

Not-to-be-forgotten modes

Incredible as it may seem, there are other similar modes already available, but we neglect to take advantage of them. I am

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THE DIGITAL PORT

continued from page 48

referring to some excellent innovations by Nino IZ8BLY, contained in the Stream package.

Packaging is probably where the neglect comes in. If you have looked at and/or used the Stream software you found it was different from our regular click and play ham programs. I am only guessing, but that little difference in appearance has likely led to general lack of acceptance.

However, I have to defend this piece of work because without Stream I am not sure if we ever would have been introduced to the MFSK mode. Within that one Stream package you will find PSK31, PSK63F, PSK125F, MFSK8, and MFSK16. Incidentally, the "F" in the two PSK modes stands for Forward Error Correction (FEC). The FEC tends to hold down the speed we are seeing with this new PSK63 we are talking about this month, but it has its advantage in that it provides dependable text transfer.

All I am saying is, I wanted to make all of you aware of these already-in-place modes, plus avoid someone sending me messages that I wasn't giving credit where credit is [also] due. All these hamware inventions are great. Some are simply underutilized.

Other stuff

Recently, I was working with the TrueTTY software — and there are a lot of new features. The first that comes to mind is that the MFSK16 mode is added. It has been there for some time, but I was working a ham who said he had tried TrueTTY a year or so back and was unaware of MFSK ability.

I too recall using the software in what might be termed its infancy, but it has really come of age. I read something recently where the author, Sergei, had added the waterfall option in addition to the spectral display for tuning. Waterfall is available for toggle by using the Alt+W hotkey.

The waterfall works very well. It was probably added because hams have become

accustomed to waterfalls over the past few years. Personally, I often prefer a spectral display for accurate and easy tuning since it gives a good perspective of quality and strength. Plus, if you use filters from your rig, it is a bit easier to tell where you are after the filter is invoked. But, for those who prefer a waterfall, TrueTTY has it now.

TrueTTY and other associated software such as AALog and CwGet are available at the DXSOFT Web site. These are shareware packages but you can download them and use them prior to registration. I see more hams using this group of software these days. Good stuff.

Speaking of innovations, I found the notch filter in the MixW2.08 after poking around a bit. I kept reading it is there, but wasn't really looking for that as much as I was the PSK63 mode. So, about the third time I right clicked on the waterfall, I got around to reading all the options in the little pop-up window and, sure enough, there it was.

Wherever you right click in the waterfall, a subsequent click on the filter line will notch out that section of the spectrum and hopefully get rid of an offensive adjacent signal. And, if that isn't fascinating enough, you can put more than one notch in at a time. That is, you can blank out the signals on both sides of the wanted signal. Looks like great fun for experimenting. Possibly, when I am trying to copy the wee little signal next to the big one I can't quite overcome with the rig filter, this will put the icing on the cake. We shall see.

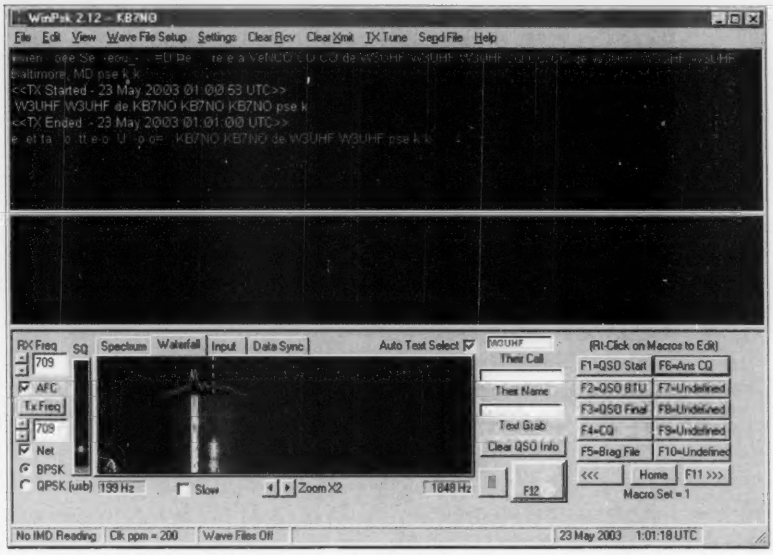

Fig. 1. 1st QSO via PSK63 — This is the WinPSK software with the PSK63 module up and running and showing evidence they heard me answer their CQ! See the text for directions to set up this bit of freeware to try this mode for yourself. The PSK63 responds the same as using PSK31 except for the speed. By my measure of timing, it is precisely twice as fast. You will be amazed. The waterfall display indicates I had a narrow filter in place from the rig, hence only two signals showing. The active trace on the left was not the answering signal. It was the one to the right that is disappearing down the waterfall. Things were going so quickly, that by the time I decided to snap the screenshot, the other station came back to me a second time. But we worked and it was only his third QSO in the PSK63 mode. Activity after these first few days picked up rapidly as two more software packages came on the scene. (See text.) At the early phase of the PSK63 adventure when this was being written, this software did not have a way to change modes without shutting down the program and rebooting from a shortcut icon. This only takes a few moments and you find is not often necessary. The other two programs that came along shortly can be switched internally. This is very fascinating, if for no other reason than it is really fast, about 100 wpm!

Things that need help

Occasionally, my super-duper Win98se system allows a little corruption in a file and it will only fix manually. This is not wholly a personal problem that occurs only at this shack. As some of you know, I have gone to extra effort to keep this version of Windows running as clean as I can, but the following scenario happens anyway.

The MixW program will load but remain minimized in the task bar. On those occasions, it is possible to get it to maximize by right clicking and then clicking Maximize — sometimes. Of course, that is not a fix even when it works.

So I found the solution is to edit a line down in the middle of the MixW2.ini file under the [Window] heading. (IsMinimized=0) changes its value to a 1 and requires editing. This has happened several times in the past year and I have noticed others complaining and looking for a fix. The only fix I know is to open the file in Notepad and edit that line.

If I were the only one with the symptoms I would not mention it here, but this may be of value to others. The fix, in the beginning, was a bit intimidating, but once I discovered the solution it is just something that must be dealt with occasionally. For-what-it-is-worth.

Power and antennas

You probably agree, if you have observed/worked the digital modes on HF for any more than a few weeks, there is not a great need for the "big signal." That is, digital modes are making it reliably to anywhere the path is open with 50 watts or less.

I was walking with the XYL the other day and we were just a few blocks from home when I pointed out that this "new" neighborhood surely had restrictions that would force a ham into using stealth style antennas. The reasoning for my statement is all the power lines, as well as phone and TV are underground there.

The wife is only vaguely interested in these facts, though she is supportive of my rights to practice ham radio with at least a reasonable size antenna aloft. What struck home to her with this subject was when I reminded her how one of our kids bought a home in southern California some years

Continued on page 61

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Doppler Antenna Design Secrets

Last call! Hams from around the country are packing their bags and making final tweaks to their radio direction finding (RDF) equipment in preparation for the Third USA Championships of Radio-Orienteering.

Members of the OH-KY-IN Amateur Radio Club are ready to greet the planes and cars bringing fans of on-foot international rules foxhunting, arriving a week or two after this magazine reaches your mailbox. There will be two challenging forest courses, July 31 on two meters and August 2 on 80 meters. Medals and adulation await the winners in each of nine age categories, five for men and boys, four for women and girls.

It's probably not too late to get in on the fun in Cincinnati. The events are open to anyone, at any RDF skill level, with or without a ham radio license. Go to [www.ardfusa.com] for the latest information and entry forms. Previous "Homing In" columns in 73 have lots of information on ARDF rules and equipment.[1] There will be a full report on this year's festivities in an upcoming issue.

Happy 200th!

"Homing In" for July explained the importance of a VHF/UHF Doppler antenna array being as nondirectional as possible. Although it may be counter-intuitive, it's true that any factor that causes the amplitude of the received signal to vary as a Doppler array is electronically "rotated" will result in the display being jumpy, hard to interpret, and perhaps even downright unreliable, especially as the vehicle moves through areas of signal reflections.

These undesirable amplitude variations can have many causes. Last time, I demonstrated that mounting a Doppler array (or any other VHF communications antenna) on the corner of a vehicle roof results in at least 4 dB amplitude variation around the azimuth circle, compared to placing it in the center of its counterpoise. Putting it on a blocked surface such as the hood or trunk is far worse. Even if you mount it right in the middle of an unobstructed ground plane, other VHF/UHF antennas in proximity can "pull" the directivity of your array.

Even more important, yet more often overlooked, is the significance of nondirectivity in the entire assembly of whips or dipoles. In the examples to follow, I'll assume a 146 MHz array of four quarter-wavelength vertical whips with typical spacing, as in Photo **A**. But the principles apply to arrays of more whips, and for other VHF/UHF bands.

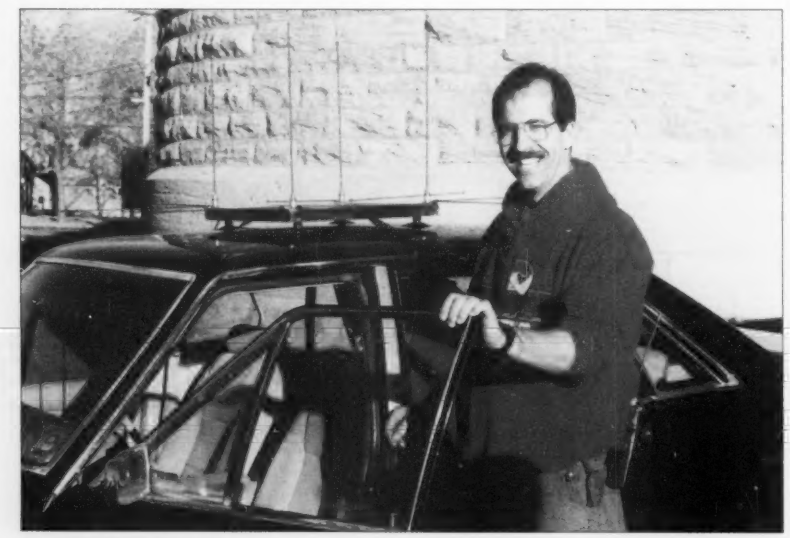

***Photo A.** Many Doppler builders choose a one-band antenna array like this one for two-meters used by Louis Tremblay VA2JX of Montreal. It has four quarter-wavelength whips in an 18-inch square pattern on a metal plate, plus eight radials to provide a symmetrical ground plane under each whip. The one-piece assembly mounts quickly and the whips are always perfectly spaced and aligned. (KØOV)*

Fig. 1 is a simplified schematic of the antenna switcher section of a typical Doppler set of the early 1980s, the Dick Smith Electronics (DSE) Model K-6345 from Australia. Series diodes D1–D4 are located on a circuit board in a plastic box, intended to be affixed to the vehicle roof with a suction cup. Wire lengths from each series diode to the common point are exactly equal, about one inch. Separate coax cables, each about 30 inches long and all four equal in length, go from the switcher to the vertical whips. At each whip base, a shunt diode (D5–D8) is connected from the whip base to the ground plane and coax shield.

To turn on each whip in sequence, a negative logic voltage is impressed through the whip's RF choke (L1-L4) such that its series diode is forward biased (on) and its shunt diode is reverse biased (off). At that instant, the other three whips get positive logic voltage to bias their series diodes off and shunt diodes on. So whenever Whip A

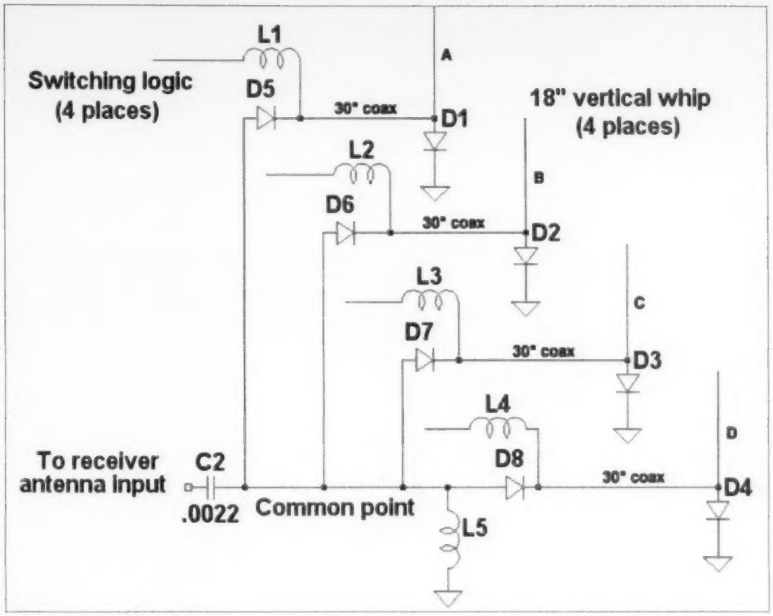

Fig. 1. Simplified schematic of the Dick Smith Doppler RF switcher section. Inductors L1-L5 are RF chokes.

is switched into the receiver, whips B, C, and D are switched out and grounded by their shunt diodes, and so forth. The logic voltages are switched in sequence at an audio rate to perform the electronic rotation of the array.

In my tests on real-world signals, the DSE K-6345 display was scrambled most of the time as I drove along. Part of that was due to inadequate damping in the audio filter and phase detector stages, but I was convinced that the antenna system deserved much of the blame. It did, as you can see from analysis of the array using EZNEC, an antenna modeling computer program for the PC.[2]

For simplicity, my model was an array of four quarter-wavelength elements in an 18-inch square pattern over a perfect ground plane at an instant in time. One whip goes to the feedline and the others are grounded, as they are in the K-6345. Sure enough, the effect of those turned-off whips tied to ground by diodes is to create a multi-element parasitic array that is highly directional in amplitude, as Fig. **2** shows. Gain of this array varies more than 11 dB around the azimuth circle. As it is electronically rotated, incoming signals and reflections undergo huge undesired amplitude jumps, in addition to the desired phase jumps.

To prove that the shunt RF diodes are the cause of the amplitude directivity problem, simply change the EZNEC model such that switched-off whips are "floating" with no connection to the ground plane, as they would be without the shunt diodes. That gives the excellent pattern of **Fig. 3.** There is just 1.3 dB variation around the azimuth circle, which is almost insignificant. Could this be an approach to the perfect Doppler array? Yes, but if the shunt diodes are simply deleted from the circuit of **Fig. 1**, we won't achieve it. That's because the switched-off whips "look back" into an uncontrolled length of coax cable terminated in an open circuit (the switched-off diodes D1-D4).

Coax as a transformer?

Let's take time out for a brief explanation

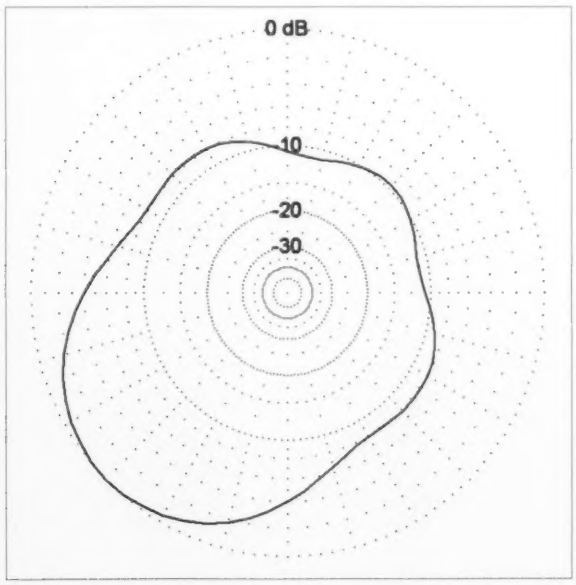

Fig. 2. ELNEC azimuth pattern plot of a 4-whip Doppler array with three whips grounded and one connected to the feedline. The large lobe is in the direction of the active whip, which is in the lower left of the array.

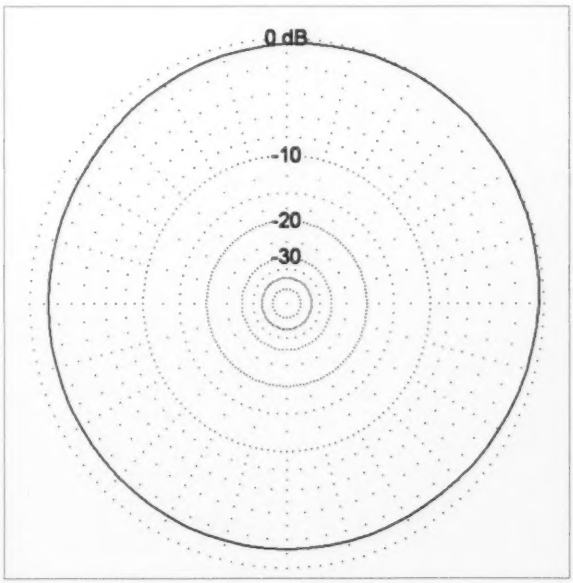

Fig. 3. The undesirable lobe disappears and a nearly perfect circular pattern with no phase anomalies is achieved when the switched-off whips are open-circuited to minimize parasitic effects.

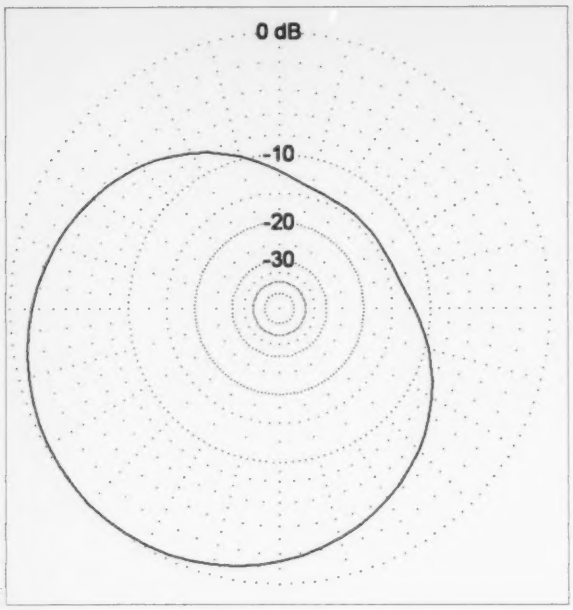

Fig. 4. With reactive termination of the switched-off whips, the amplitude pattern is even worse than for the grounded case.

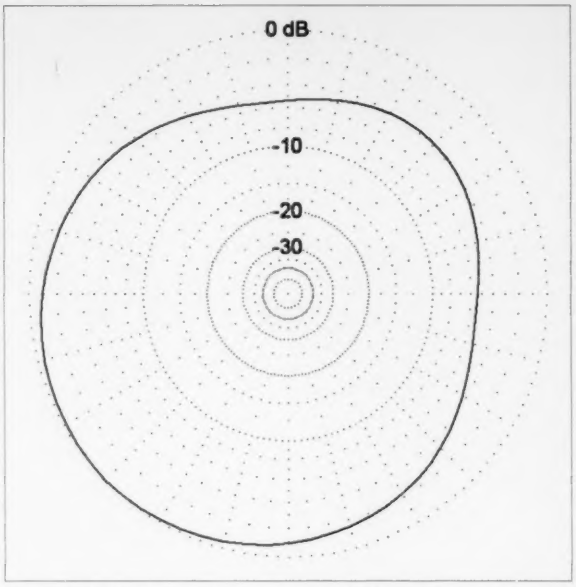

Fig. 5. When inactive whips are terminated by 50 ohms, as they are in preamp-type Doppler switchers, the directivity is acceptable. But it's not as good as in the open-circuit case.

of the effect of transmission line length on impedance mismatches. Perhaps you have heard of using "stubs" to get optimum SWR on coax or ladder line when your antenna or other RF load doesn't have the same impedance as the line. When a mismatch occurs, the effective impedance at any point in the line varies along the length, as does the RF voltage and current.

These variations are periodic, repeating almost exactly every half-wavelength. The only variations in these half-wavelength repetitions are caused by RF losses in the coax. They can usually be neglected unless the line is very long or very lossy. The ratio of maximum to minimum current, voltage, or equivalent impedance along any half-wavelength section of the line is the SWR.

If we know the terminating impedance and line length, we can determine the transformed impedance at the radio end of a transmission line by several methods, including computer analysis. The easiest and most familiar way for long-time hams and engineers is the Smith chart.[3] This graphical aid shows the impedance transformation for any line length and any terminating impedance, relative to the cable's characteristic impedance.

For instance, if you develop a short at the antenna end of your station's feedline, your transmitter will not "see" a short at the shack end of the coax unless the line length is exactly an electrical half-wavelength. If the line is very short, about one-eighth wavelength, the line-load combination will appear as if it were a resistor and an inductor. At 3/8 wavelength, it appears resistive and capacitive. And at 1/4 wavelength, the short circuit load is transformed into the equivalent of an open circuit! For longer lines, the transformations repeat every half-wavelength.

There are some simple transformations for which we don't need a computer program or Smith chart. For instance, an electrical half-wavelength is effectively a 1:1 transformer. A 70-ohm antenna will appear to the transmitter as exactly 70 ohms at the end of a half-wavelength of coax, even if it's 50-ohm coax. A quarter wavelength of line inverts the impedance, turning opens into shorts and vice versa. A 10-ohm resistor appears as a 250-ohm load at the far end of an electrical quarter-wavelength of 50-ohm coax.

Note the term "electrical length." Waves slow down in practical transmission lines. The velocity factor of solid polyethylene dielectric coax (such as RG-58) is about 66 per cent, meaning that an electrical quarter wavelength of it at two meters is close to 13 inches, compared to about 19.5 inches in air. Other cables, such as foam dielectric types, have different velocity factors. There is a table of values in The *ARRL Handbook*.

What is the equivalent impedance seen by the switched-off whips in the DSE Doppler when the shunt diodes are removed? The practical open-circuit resistance of the series diodes is transformed by about 220 electrical degrees of coax into a complex impedance. The Smith chart answer is 9.5 + j48.5 ohms, the equivalent of a 9.5 ohm resistor and 53 nanohenry inductor from the base of each parasitic whip to ground plane. Plugging that into the EZNEC analysis gives the pattern of **Fig. 4**. Wow, there is over 14.1 dB variation, even worse than the shunt diode case!

How can the DSE circuit be changed to get the desired pattern of **Fig. 3**? It's easy, just cut the lengths of the coax lines between the series diodes and whip bases to one-half electrical wavelength, which is 26 inches of non-foam RG-58. That length moves the open circuit of the series diodes once around the Smith chart to present a perfect open circuit at the whip bases. This modification helped make major improvements to the performance of the Dick Smith Doppler set when I did a product review of it 16 years ago. I wrote an article about my findings[4] and subsequently heard from many other hams who made the changes with similar results.

For the Roanoke Doppler in my book,[5] I used coax impedance transformation in a different way. There are no series diodes. Shunt diodes are in the exact center of an electrical half-wavelength of coax line for each whip. At each instant, the diode for the active whip is biased off and the three others are biased on, shunting RF from those whips to ground. The electrical quarter-wavelengths of coax on each side of the shunt diode transform the RF short of the diode to an effective open circuit at each

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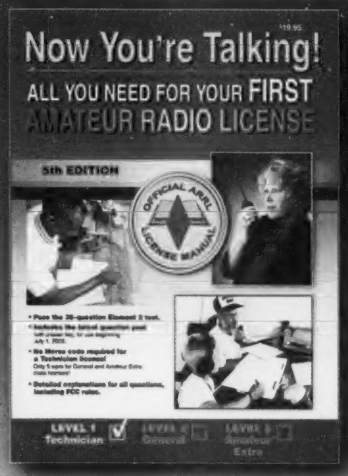
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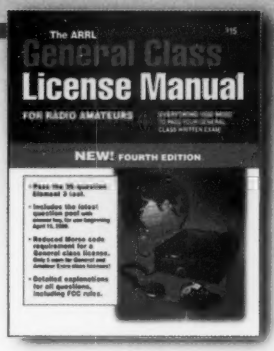

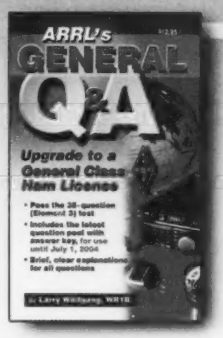

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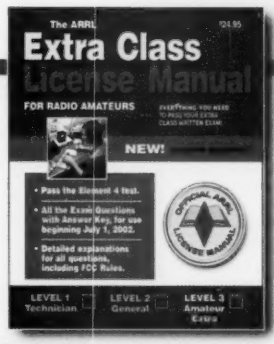

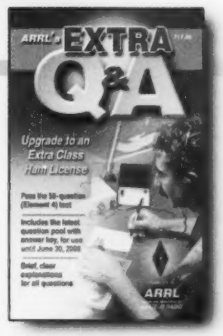

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HOMING IN

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end, making possible the ideal amplitude pattern of **Fig. 3** and preventing the shunt diodes from loading down the RF common point.

Whichever circuit you choose, these Doppler antenna switching schemes can provide excellent results if you carefully trim the individual whip coaxes. The downside is that they work well over just a narrow frequency range, such as a single ham band. A switcher built for the 120 MHz aircraft band wouldn't be right for the two-meter ham band, because the coax lines would create reactive terminations on 2m. For a one-band one-piece array such as **Photo A**, that's not a problem. But the switcher for a set of four mag-mount antennas with whip lengths and spacings changeable for multiple bands must be more frequency-independent.

I solved that problem with a new design that has series diodes at both ends of the coax, to ensure that switched-off whips see an open circuit and the common point isn't loaded down, no matter what the electrical length of the coax. (All four coaxes still have to be exactly the same length, of course.) Complete plans for this wide-range Doppler switcher can be downloaded from the "Homing In" Web site. It works with the Roanoke Doppler and features bipolar biasing of the PIN diodes to minimize on-resistance (lower loss) and maximum off resistance (best isolation). It can be adapted to many other Doppler set designs.

50 ohms all the way

Some designers of commercial and home-built Doppler sets prefer to use active preamps for each antenna element, switched on and off to create the pseudo-rotation of the array. The preamps must be identical and coax line lengths must be exactly equal to achieve equal phase lengths around the array. Since preamp input and output ports are intended to match 50-ohm coax, relative line length should not be a consideration and wide frequency range should be achievable, limited only by the preamp bandwidth.

What does 50-ohm resistive loading of inactive whips do to the amplitude response of the array? The EZNEC answer is in **Fig. 5.** Gain variation is 5.4 dB. That's low enough directivity for acceptable performance in multipath, but I prefer the dual-diode approach of the Roanoke wide-range switcher. Monolithic preamps have gain, which can overcome the small amount of loss in the coax from antenna to receiver. But they usually have noise figure that is much worse than most receivers. So unless you are using a very insensitive receiver, there is a good chance that antenna preamps will do more harm than good from an overall sensitivity standpoint. What's more, RF gain ahead of the receiver will worsen any receiver overload and cross-modulation problems. Strong signals can also overload the preamps, distorting the incoming signal phase and degrading the bearing accuracy.

One last point for now: Use good PIN-type diodes in your Doppler switcher, not ordinary silicon switching diodes. PIN diodes provide significantly less insertion loss when on, if biased properly, meaning that a PIN switcher will generally have less loss. More importantly, stray RF rectification is much less likely with PINs. In my tests, I encountered significant cross-modulation problems using a Doppler with non-PINs, especially when driving near strong RF sources. Suppliers of PIN diodes are listed in the Hardware Sources page of the "Homing In" Web site.

OK, you have optimized your switcher design for zero loading of switched-off whips. You found the perfect centered place to mount the array on the vehicle and you moved all the other antennas far away. But your mag-mount Doppler set display still dashes around in multipath more than you'd like. Are there more secrets of success for Doppler antenna sets? Yes, and they're coming in the next installment of this series. Meanwhile, I want to hear about your experiences in building and using Doppler RDF sets. Send stories and photos via Internet or the Post Office to the addresses at the beginning of this article.

Notes

1. "Homing In: Two New Tools for T-Hunting" in 73 *Magazine* for April 2003 has more details on the championships and a new ARDF set for two meters.

2. By Roy Lewallen W7EL, [www.eznec.com].

3. Smith chart is a registered trademark owned by Analog Instruments Company, New Providence, NJ. Detailed explanations of coax impedance transformation, stubs, and the Smith chart are in recent editions of The *ARRL Handbook* and *The ARRL Antenna Book.* Smith chart resources on the Web include [http://www.scott-inc.com/html/smith.htm].

4. Moell, "The Weekender: An Improved RDF," Ham *Radio Magazine,* July 1987. This article is available at the "Homing In" Web site under the title "Improving the Dick Smith Radio Direction Finder."

5. Moell and Curlee, T*ransmitter Hunting — Radio Direction Finding Simplified,* TAB McGraw-Hill, ISBN 0-8306-2701-4. Plans for the Roanoke Doppler are in Chapter 9. 73

Clamp-On DC Ammeter

continued from page 17

aspects of the project that come to mind are: (1) sensitivity to extraneous ferrous objects; (2) noise within the amplifier; and (3) the high supply voltage requirement for portable operation. Even the errors in calibration are tolerable as long as the indication error is known.

On the positive side, the experience gained through experimentation with Hall-Effect devices opens the door for "new" projects. I suspect that there are many applications that apply to ham radio projects, but we as hams need to ferret them out and expose them for the rest of us to use. Consider these applications as a starter: indicating burned out lights on a vehicle; indicating when power is applied to a remote piece of equipment; as a remote ammeter for cars and airplanes; and/or indicating the current value being drawn by a remote piece of equipment. The number of desirable applications is limited only by your imagination.

I hope that you will find some merit in building and experimenting with the ammeter, even though you may not have a direct use application in mind at this time. What you gain from the exposure to Hall-Effect sensors is well worth the effort. Should you have an interest in this type of a project, please feel free to change the design to fit your application and need. 73!

Reference listings

- Allegro Microsystems, 115 Northeast Cutoff, Box 15036, Worcester MA 01615-0036.
- Allegro Microsystems, 162 Pembroke Rd., Concord NH 03301; phone 505-853-5000.
- Hall-Effect sensor, p/n A3515EUA or A3517EUA. Approximate cost, $1.00 each plus shipping. Single/multiple part ordering info, on-line credit card purchase only: [www.allegroebiz.com/ebiz1/purchase/]. (a) Special purchase log-on. (b) Create an account. (c) Provide the requested information.
- Hall-Effect data book, AMS-702 and app. note 27701 [www.allegromicro.com]. A3515xUA data sheet 27501.10B.
- Cores available from All Electronics, 1-800-826-5432 or [www.allcorp.com]. Cores: TOR-4, 0.50 o.d., 0.28 i.d., 0.18 wide, 10 @ $1.00. TOR-23, 0.50 o.d., 0.30 i.d., 0.10 wide, 10 @ $1.00. TOR-28, 0.87 o.d., 0.50 i.d., 0.25 wide, 3 @ $1.00.
- Cutoff disks. Available in most hardware stores. Forney, Cat. 71794, 3" diam. with a 1/2" center hole. Harbor Freight, phone 1-800-423-2567, fax 1-800-905-5220: 4.5" diam., 1/16" thick, p/n 4530, 10 @ $7.00. 4.0" diam., 1/16" thick, p/n 4532, 10 @ $7.00.
- Hall-Effect Sensor Experiments, 73 Amateur Radio Today, pg. 25, January 2003, Hugh Wells W6WTU. 73

The Ins and Outs of Parts Substitution

continued from page 22

circuit. Therefore, matching a silicon NPN or PNP for a like germanium device may not always create the desired results. The solution may require a complete circuit parameter evaluation to restore the desired function. In other words, the modern transistor must have its functional parameters met for the circuit to function as desired.

Comments

If you've followed along with the details of the discussion up to this point you'll see that there are many decisions involved in making a substitution "call" for a specific device. However, the "call" is aided with a little legwork that leads one through the process of understanding what the part is being asked to do in the circuit, and then selecting an available part that will fit into the roll of the requested one.

Part 1 of this series provided the typical steps involved in examining the part, circuit, and the tools that are available to assist in finding a substitute part. Part 2 will pick up with a continuation of the selection process as it relates to FETs, ICs, and special devices. 73

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UG-21B/U	N Male RG-8 , 213, 214	5.00
9913/PIN	N Male Pin for F-7, 9086, 8214,LMR-400 Fits UG-21 D/U & UG-21 B/UN's	1.50
UG-21D/9913	N Male for RG-8 with 9913 Pin	4.00
UG-21B/9913	N Male for RG-8 with 9913 Pin	6.00
UG-146A/U	N Male to SO-239, Teflon USA	8.50
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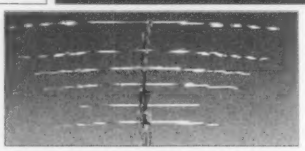

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How to Check Transistors with an Ohmmeter

continued from page 24

power transistors, it will probably be necessary to switch to a lower resistance scale to get a usable reading.

Usually you need not worry about burning the transistor up with excessive current, as power transistors are designed to stand far more than the 100 milliamperes or so of the normal ohmmeter on the R X 1 scale. On the other hand, these new, small-signal silicon transistors have such small leakage currents that it is often impossible to get any reading with the base open and using the R X 100 scale. This need not be a deterrent, however; just go right ahead and touch the base lead to the collector — the ohmmeter should now read something downscale from the infinity mark, indicating a good transistor. You can switch to a higher resistance scale, but care must be taken that the voltage ratings of the transistor will not be exceeded as normally a higher battery voltage is used on the higher resistance ranges.

Incidentally, almost all ohmmeters, with the exception of the Simpson model 260, have their polarities reversed on ohms. That is, the black or common lead is tied to the positive side of the battery and the red lead is tied to the negative side of the battery. If you are in doubt as to your particular meter and do not have a separate meter to check, don't despair, just find an old diode that is marked and measure its resistance. In one position the resistance will be low and in the other position the resistance will be high. The negative lead on your ohmmeter will be the one that is on the cathode of the diode when it is in the low resistance position. The cathode end of a diode is usually marked with a black band. In any case, it is the lead opposite the arrow in the diode symbol.

Fig. 4 shows the standardized lead configurations for most transistors. Unfortunately some transistors, especially the high power ones, do not follow a standard lead pattern. Normally in these the collector is tied to the case and the larger of the two leads is the emitter. In case you cannot decide which lead is which, try the original ohmmeter test on the diodes. Measure the resistance between any two leads, reverse the leads, and measure again. If there is a large difference in the readings, one of your transistor leads is the base. The lead that shows a difference in forward to backward resistance to both of the other leads is the base. The two leads that show no or the least difference are the collector and emitter.

By knowing which lead is the base, you can try the other two leads both ways to see which polarity gives a resistance decrease when the base is connected to the negative terminal. Assuming that you are dealing with a PNP device (which will be true 99 and 44/100% of the time for commercial transistors), the collector is the lead tied to the negative terminal.

This method, while not the world's best, is probably the world's cheapest, especially if you already own an ohmmeter! It certainly is as good as these cheap transistor testers one sees flooding the market, and a good deal handier. You just have to know how to cheat.

I would like to thank Mr. Jerrold Ford for the original idea and Mr. Robert Atherton for his help. 73

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Two Monitors Are Better Than One

continued from page 25

may having running in the second monitor. I can transfer anything from one document to the other without having to go away from the one I am using. You can work in either screen you want by just using the mouse to go to it.

It is very handy when you have a program up and running but want to get something from the desktop. For instance, I am now running the MixW program for PSK and have it minimized and moved to the left monitor. Now I can run the Wordpad program on the main computer and bring up the Wordpad again on the left monitor on top of the MixW program, and copy from one program to the other by just doing copy and paste. If I want to go to the MixW program, I just click on its running part and away I go, using it in whichever monitor I want.

If you have the Callbook loaded, you can run it on one monitor while using the program in the other. Then when you want to look up who you are working, you can just go to the logbook without leaving the program you are running. While watching my program Mix, I leave it running on the second monitor on the left while I go to the Internet and send cards to whomever I have worked via EQSL.CC. I can see the log in the Mix and copy the information I need to put on the cards.

Photo A shows my shack with the two monitors. The meter on the top of the main computer is a field strength meter which tells me that the transmitter is putting out RF. I sometimes change the background in the desktop to black, as it makes it easier to tell where the cursor is.

Now I can't see how I ever got by without using two monitors. I hope you get as much pleasure from this as I do. Look for me on PSK at approximately 14.070 PSK. 73 … 73

Say You Saw It in *73!*

G.I. Joe and Mr. Morse

continued from page 33

Signal Collection/Manual Morse Operator/Analyst,[http://usmilitary.about.com/library/milinfo/marinennjobs/bl2621.htm].

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Above & Beyond

continued from page 43

leads and you should see the same junction resistance to ground on the second diode, which is connected in an anti-parallel configuration.

Now, with two diodes connected and testing good, make the IF port by connecting a single strand of the finest-gauge wire you can find. I used a single strand of 110 volt AC lamp cord and soldered one end of this single strand to the diode center connector. The other end is soldered to the unmodified SMA connector. This is the 2-meter IF port.

The drive from the 10 GHz synthesizer is the LO port of the mixer. The RF port is somewhat unconventional; it is the focused RF energy directed to the diodes on the back of the SMA connector themselves. Kerry had a 4-inch dish on his rig and pointed the mixer diodes into the dish at the focus point of the dish for tests. The diodes and SMA connectors were supported by 0.141 coax hard-line, positioning the mixer diodes to the focus point of the dish.

Other interesting applications from the mixer are its harmonic generating possibilities. Driving it at much lower frequencies into a single or even 2 diode arrangement works very well. This mixer has great harmonic generation capabilities. Frequency markers from lower frequency oscillators have been observed as high as 10 GHz and as few at 24 GHz. The diodes used were "fly spec" size diodes and are quite small. They were used in commercial applications for 14 GHz so they exhibited great microwave capabilities already and were in a Stripline package that permitted us to solder them to the back of a SMA connector.

As is all material used in this project, even the SMA connectors were surplus. They were still a bargain and obtained at local swap meets. Even though it used some sophisticated components, most parts for this construction can be had in one form or another by using some good search techniques in your quest for that key component for your surplus junk box. As always, for any questions on this and other items please E-mail me at [clhough@pacbell.net] and I will try to answer your questions as best as I can. Good junk box hunting, 73, Chuck WB6IGP. 73

Travels with Henryk — Part 14

continued from page 27

issued in Delhi, in the north, and it takes a very long time to get anything processed there. Goa is still distinct in many ways from the rest of India. Everything is still influenced by the ages of Portuguese rule. Even the names — VU2CY is Cyril Salvador Martin,

Continued on page 61

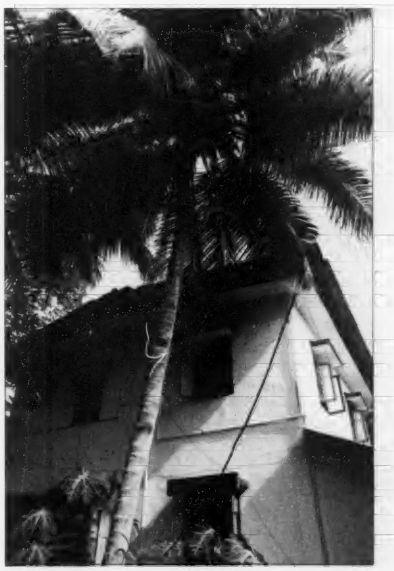

***Photo G.** VU2FCX's assortment of wire antennas.*

PROPAGATION

Jim Gray II
210 East Chateau Cir.
Payson AZ 85541
[akdhc2pilot@yahoo.com]

The Good, the Bad, and the GLE

August promises to be an interesting month, with propagation conditions ranging from good to spectacularly bad.

The first half of the month will be similar to what July had to offer, with a few Good (G) days intermingled with numerous Fair-to-Good (F-G) and Fair-to-Poor (F-P) ones. However, beginning late on the 19th, I expect conditions to rapidly deteriorate with one or more large solar eruptions likely from the 20th through the 25th. I wouldn't be surprised if we see a major X-class flare or CME (Coronal Mass Ejection) accompanied by a proton burst that causes what is known as a GLE, or Ground Level Event. These are relatively rare occurrences that result in daylong radio blackouts and can cause surges in the electrical power distribution grid. Some of you may remember a flare on March 13–14, 1989, that completely disrupted the ionosphere for nearly 48 hours and triggered a widespread power outage in eastern Canada and parts of the northeastern US.

Whether or not my dire solar prediction for the third week of August comes to pass, we can certainly expect to witness another spectacular event — the peak of the Perseid meteor shower. Every summer, from July 23rd through August 20th, there is a marked increase in meteor activity as the earth passes through a relatively dense region of dust and debris left behind by the Swift-Tuttle comet. This annual event is named the Perseids because the meteors appear to emanate from the constellation Perseus. The "grande finale" for 2003 will occur on August 13th at around 0500 UTC, when we can expect to observe up to 75 "shooting stars" per minute.

Always a big event for star-gazers, the Perseids also come high on the list of many DXers since meteor showers can produce some astonishing radio propagation conditions. Known as "meteor scatter," it is not uncommon for radio signals to propagate up to 1,400 miles when reflected from the ionized trail of a meteor. You can usually recognize meteor scatter from the audible whistles and pings they create, or the echo that they add to a signal. When a meteor

August 2003

SUN	MON	TUE	WED	THU	FRI	SAT
					1 F-G	2 G
3 F-G	4 F	5 F-G	6 F-G	7 F-P	8 F-P	9 G
10 F-G	11 F-G	12 F-G	13 G	14 F-G	15 F	16 F-P
17 F-P	18 F-P	19 F-P	20 VP	21 VP	22 VP	23 P
24 P	25 F-P	26 F-P	27 F-P	28 F	29 F	30 F
31 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
Central America	15-20	(15) 30	20 (40)	(20-40)	x	(20)	20	(20)	(15)	(15)	15 (20)	(10) 17
South America	15 (20)	(15) 20	20 (40)	(20-40)	(20)	x	(15)	(15)	x	(10)	(10-20)	(10) 20
Western Europe	20	20	(20-40)	(40)	x	(20)	x	x	x	x	(20)	20
South Africa	x	(40)	x	(20)	x	x	x	x	(15)	(15)	x	x
Eastern Europe	20	20 (40)	(20)	x	x	x	(20)	x	x	(15)	(15)	(20)
Middle East	20	20 (40)	(20)	x	x	x	x	x	x	x	(20)	(15)
India/ Pakistan	(15-20)	(20)	x	x	(20)	x	x	x	x	x	x	x
Far East/ Japan	(15)	x	x	x	x	x	(20)	(15-20)	(15)	x	x	(15)
Southeast Asia	(15-20)	x	x	(20)	x	x	(20)	x	x	(15)	x	x
Australia	(15)	(15)	x	x	(20-30)	(20-30)	(20)	(20)	x	x	x	x
Alaska	(15-20)	(15-20)	(15-20)	20	20 (40)	(20-40)	(20)	(20)	x	x	(15)	(15-20)
Hawaii	(15-20)	(15-20)	(15-20)	20	20 (40)	(20-40)	(20)	(20)	x	x	x	(15)
Western USA	(10) 30	(10) 30	(10) 40	(15) 40	(20) 40	(20-40)	(15) 20	(10) 20	(10-20)	(10-20)	(10-20)	(10) 20

CENTRAL UNITED STATES TO:

Central America	(10) 20	(15) 30	20 (40)	20 (40)	(20-40)	(20)	(20)	(15) 20	(15-20)	(10-20)	(10-20)	(10) 17
South America	10 (20)	(10) 20	(15) 30	(15) 30	(20-40)	(20)	(20)	(15)	(15)	(10)	(10-15)	(10-20)
Western Europe	(15) 20	20	(20-40)	(20-40)	x	(20)	(20)	x	x	x	x	(15-20)
South Africa	x	x	(40)	(20-40)	(20)	x	x	x	(10-15)	(10-20)	(20)	x
Eastern Europe	(20)	(20)	(20)	(20)	x	x	(20)	(20)	x	(15)	(15-20)	(15-20)
Middle East	(15-20)	(20)	(20)	(20)	x	x	x	x	x	x	(20)	(20)
India/ Pakistan	(15-20)	(15-20)	(20)	x	x	x	(20)	x	x	x	x	x
Far East/ Japan	x	(15)	(15)	x	x	(20-40)	(20)	20	(20)	x	x	x
Southeast Asia	(15)	(15)	(15-20)	(20)	x	x	(20)	(20)	(15-20)	(15)	(15)	x
Australia	(15)	(15)	(15)	(20)	20 (40)	(20-40)	(20-40)	20	(20)	x	(15)	x
Alaska	(10) 30	(10) 30	(10) 40	(15) 40	(20) 40	(20) 40	(20-40)	(15-40)	(10) 30	(10-20)	(10-20)	(10) 20
Hawaii	(15-20)	15 (20)	(15-20)	20	20	(20)	20	(20)	x	x	x	(15)

WESTERN UNITED STATES TO:

Central America	(10) 17	(15) 20	(15) 20	20	(20)	(20)	(20)	(20)	(20)	(10-20)	(10-15)	(15-20)
South America	(10-20)	(10) 17	15-20	(15) 20	(20)	(20)	(20)	(15)	(15)	x	(15)	(10-15)
Western Europe	(15-20)	(20)	20	(20)	x	x	x	(20)	(15)	(15)	(20)	(15-20)
South Africa	x	x	x	(20)	(20)	x	x	(20)	(20)	(15)	x	x
Eastern Europe	(15-20)	(20)	(20)	(20)	x	x	x	(20)	x	x	x	(15-20)
Middle East	(20)	(15-20)	(15-20)	(20)	x	x	x	x	x	x	x	(20)
India/ Pakistan	x	x	(15)	x	x	x	x	(20)	x	(15)	x	x
Far East/ Japan	(15)	(15)	(20)	(20)	(20)	(20-40)	(20-40)	(20)	(20)	(15-20)	x	(15)
Southeast Asia	x	x	(15)	(15)	x	(20)	(20)	(20)	(15-20)	(15-20)	(15)	x
Australia	(10-15)	(10-15)	15	(15-20)	20	20	20	(20)	20	(20)	x	(15)
Alaska	(10) 40	(10) 40	(10) 40	(15) 40	(20) 40	(20) 40	(20-40)	20-40	(15) 40	(10) 40	(10) 40	(10) 40
Hawaii	(10-15)	(10-20)	(10-20)	(15-20)	20	20	(20-40)	20 (40)	(20-40)	x	x	(10-15)
Eastern USA	(10) 30	(10) 30	(10) 40	(15) 40	(20) 40	(20) 40	(20-40)	(15-20)	(10) 20	(10-20)	(10-20)	(10) 20

Table 1. *Band, time, country chart. Plain numerals indicate bands which should be workable on Fair to Good (F-G) and Good (G) days. Numbers in parentheses indicate bands usually workable on Good (G) days only. Dual numbers indicate that the intervening bands should also be usable. When one number appears in parentheses, that end of the range will probably be open on Good (G) days only.*

burns up high in the atmosphere (typically 65-70 miles), it leaves a momentary trail of highly ionized gas behind it, and if the geometry is right you can make short duration QSOs. Computer-aided high speed CW is the preferred method for making contacts and the VHF 2-meter and 6-meter bands are normally used, but there is a growing interest among hams on the 10-meter HF band as well.

Obviously there isn't enough room here to explain the ins and outs of meteor scatter DXing, but there has been much written on the subject. Two good sources of information that can be found on the Internet are the Web sites at [www.nr6ca.org/meteors] and [www.meteorscatter.net/ms].

73 until next month, Jim.

Band-by-band forecast

10-12 meters. Conditions will be only fair but you can expect seasonal improvements toward the end of the month. The best openings will generally be toward the southeast in the morning and to the southwest in the afternoon. As is typical during the summer months, the strongest and most reliable paths will be to Central and South America. Daytime short-skip will range from 1,000 to approximately 2,300 miles.

15-17 meters. Some decent openings should be available to Southern Europe and parts of Africa in the morning, Latin America in the early afternoon through mid-evening, and Australia or Southeast Asia from late afternoon up to midnight. On Good (G) days a single skip distance of up to 2,400 miles is possible, although the average is more likely to be somewhere between 1,000 and 1,800 miles. Moderate duration sporadic-E openings should also be fairly common throughout the month, especially if you work toward the east before local noon.

20 meters. Good daytime opportunities should be available throughout the month, with evening and nighttime conditions improving dramatically as September approaches. In the mean time, look for peak periods an hour or two after sunrise and again in the late afternoon. Europe and Africa should provide steady fare if you're situated in the eastern half of the U.S., while those west of the Mississippi will find that the South Pacific, Australia, and Indonesia will be more readily available. As always, the Caribbean and South America should be open to nearly everyone at most hours of the day and night. Short skip will be between 500 and 2,200 miles.

30–40 meters. Some weak worldwide openings are available from sunset to sunrise on most days, but this is hurricane season so expect a lot of atmospheric noise much of the time. During the quieter periods, operators in the Central and Western U.S. should find some strong openings across the Pacific to New Zealand, Australia, and Indonesia, while those on the East Coast will find Western Europe and North Africa more accessible. Short-skip at night will range from 500 to 2,500 miles but will be limited to less than 1,000 miles during the day.

80-160 meters. Only fair worldwide opportunities will exist between sunset through sunrise on the quieter days, so don't expect much action here. If 40 meters seems to be doing well then some good opportunities may also be available on 80, but 160 will usually be buried in atmospheric noise. Look for peaks just after midnight and again just before sunrise. Daytime skip will be very short — under 250 miles — but nighttime skip can range from 1,000 to 2,000 miles. 73

Travels with Henryk — Part 14

continued from page 59

VU2FCX is Alex Fernandes, and VU2DM is Didier Jose Di Melo.

After two weeks of rambling on the Indian coast of the Arabian Sea, it was time to fly back to cold and dark Stockholm. Early morning, while queuing for the check-in counter at the Dabolim airport, I was approached by an officer holding a handheld radio. "Oh gosh," I said to myself, "some kind of trouble?"

The officer introduced himself — "I am VU2FCX, Alex." That was a very pleasant surprise and a wrap-up of my visit to Goa. Alex works at the airport of Dabolim, the same airport that Luis Catulo worked at more than 40 years ago. 73

The Digital Port

continued from page 51

back and even the barest essential TV antenna had to be hidden from view even though the local cable would not be available there for several months.

What I am getting to is the fact digital has come along at an ideal time. Like most hams, I find great success with 20 to 30 watts. When I read the instructions for using the PSK63, it mentioned the need to boost the power. The first few tries were unsuccessful at 25 watts, so I cranked up to 50 watts, but found that was not necessary.

As with most ham paths, it is only necessary to be in the right place at the right time. I found the other operators were enjoying success without extra power, so PSK63 follows the digital power norm.

What gets me riled is all the restrictions put in place that cause hams to build antennas in their attic or enclose them in a flag pole. And I am not sure what else is being used by to satisfy those who would mandate a pristine countryside for their residence.

Anyway, with that little bit of ranting done with, the real secret to ham success on HF lies in the use of the modes we discuss here. It is a wonder to me how, seemingly, so little notice is given in other publications and in most club activities of the great advantages of this technology (and did I mention Fun?)

We have the answer here, and I think it is because of the dedication of some really great programmers and a whole bunch of contributions from technically oriented hams.

That's it for this month. Keep those digital fires burning, 73 Jack KB7NO. 73

QRX

continued from page 7

1. Cyclogenesis refers to?
   a. the development of a warm front
   b. the development of a high pressure system
   c. the development of a low pressure system
   d. fair weather

2. What is the average sea level pressure in millibars?
   a. 925
   b. 29.92
   c. 101.1
   d. 1013

3. What is vorticity?
   a. force of the movement of the air
   b. measure of the rotational spin at a point within a fluid
   c. the rate of uplift of air
   d. vertical stretching of a parcel of air

4. The most windy location in the U.S. based on average wind speed?
   a. Mt. Washington, NH
   b. St. Paul Island, AK
   c. Cold Bay, AK

5. The National Weather Service is under what federal department?
   a. Department of Interior
   b. Department of Agriculture

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QRX

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c. Department of Defense
d. Department of Commerce

6. The snowiest U.S. location based on annual average snowfall?
a. Mt. Washington, NH
b. Watertown, NY
c. Valdez, AK
d. Stampede Pass, WA

Answers to WX trivia questions: 1. c; 2. d; 3. b; 4. a; 5. d; 6. d.

Thanks to the Spring 2003 issue of Radiogram, *published by the Capital City Repeater Association of Columbus, OH.*

The Ever Changing Brain

If you have ever taken a taxi in a major city, you may have wondered how the taxi drivers know how to reach even the most obscure destination without a street map or a hint from their passengers. Well, a new study indicates cabbies are working their brains so hard that they become enlarged in the zone associated with navigation.

According to the study published in the journal *Proceedings of the National Academy of Sciences,* the drivers' brains adapted to help them store a detailed mental map of the city. This, by shrinking in one area to allow growth in another called the rear hippocampus.

In the latest study, researchers at University College, London University, compared the brains of 16 male taxi drivers with those of 50 other men of a similar age. They found that among the cabbies, the back of the hippocampus, the part of the brain associated with spatial memory, was larger than it was in the comparison group.

Scientists had previously reported differences in the structure of the brain between musicians and nonmusicians. Researchers say that evidence that the brain is physically able to change according to the way it is used could be important in understanding human development.

Thanks to Science Today, *via* Newsline, *Bill Pasternak WA6ITF, editor.*

RF Safety

Since we are now on the declining side of the sunspot cycle, the HF bands aren't quite as hot. The temptation to buy an amplifier to help out during these poorer band conditions is getting stronger. Several manufacturers make affordable amplifiers in the 500 to 700 watts range. That extra punch will help get your signal out, but there are other things to take into account before you fire it up.

Did you know that every time you fill out a form 605 to renew or upgrade your license, you certify that you are in compliance with the RF safety regulations? The line reads:

"I have read and WILL COMPLY with Section 97.13(c) of the Commission's Rules regarding RADIO FREQUENCY (RF) RADIATION SAFETY and the Amateur Service section of OST/OET Bulletin Number 65."

When you have time, read the full section, but right now I'll summarize the rule. It is available at [http://www.arrl.org/FandES/field/regulations/news/part97/]

97.13(c). In summary, it says: Before causing or allowing an amateur station to transmit from any place where the operation of the station could cause human exposure to RF electromagnetic fields ... (1) The licensee must perform the routine RF environmental evaluation ... (2) If the routine environmental evaluation indicates that the RF electromagnetic fields could exceed the limits ... in accessible areas, the licensee must take action to prevent human exposure to such RF electromagnetic fields ...

Think about your antenna installation. How far is it from your neighbor's property line? Do you have a fence around your yard to restrict people or animals from entering? Can you touch your antenna from the ground? Do you have children ... who play in the yard where your antenna is located? Does your neighbor have children who could wander into your yard while chasing a ball or playing games?

The rules talk about controlled and uncontrolled exposure. Controlled environments relate to those who know they are being exposed to RF. Your family usually knows when you are on your radio. Do the neighbors know they are being exposed to RF radiation? This is where the uncontrolled part is very important.

Let's use our club's 10-meter net frequency, 28,410 MHz, as an example. For simplicity, let's use 100 watts output into a dipole antenna. The formula shows that it is safe for a controlled environment at 5.76 feet and an uncontrolled environment at 12.82 feet.

Now, if you recalculate the same frequency with the power output from an amplifier at 500 watts, the new calculations show that a controlled environment is OK at 12.82 feet and uncontrolled at 28.61 feet.

Now, let's take the power up to the legal limit of 1500 watts: The controlled distance goes out to 22.18 feet and the uncontrolled is out to 49.52 feet. As you can see, the bigger the tower, the easier it is to comply with the regulations. But what if we don't have a big tower? Maybe we use a ground-mounted vertical on our city lot.

Don't let the math scare you away from doing the calculations. You can use a Web site found at [http://n5xu.ae.utexas.edu/rfsafety/]. This is a good site to plug in the numbers and find out how well your station complies. I recommend that you print out the results and put them in your logbook in case your neighbors have questions about RF safety. It will help satisfy their concerns when they see that you have done the calculations and have documented the safe operation of your station.

Thanks to Rick WØPC, via GARBLE, *the monthly publication of the St. Charles Amateur Radio Club, Inc., April 2003.* 73

Never say die

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their courses by explaining what their students are going to learn, and how this could possibly benefit them in life. Imagine the double talk when they try to rationalize teaching trig and the binomial theorem.

The music reading course made it easy for me to get involved with singing in a choir as a boy soprano, and going on to sing in bigger and better choruses. The art appreciation course was of enormous value to me when I started in television as a cameraman. It also made my pictures more interesting when I got involved with photography in high school, where I joined the camera club and spent many, many happy hours in the darkroom developing and printing my pictures.

The weekly music appreciation sessions at PS 99 in Brooklyn for the whole school helped my instinctual love of classical music grow. This was instrumental (sorry about that) in my getting started with my first major independent business, manufacturing hi-fi loudspeaker cabinets. And when the compact disc came along, my love of music made publishing *CD Review* great fun.

High school was a terrible bore, made bearable by the after school clubs ... there was a choice of 120 of 'em. I opted for the Savoyards, where we put on Gilbert & Sullivan operettas; the camera club; the radio club (W2ANU); and the book club. The Choral Club rehearsed every day, second period, and put on some exciting radio and public concerts.

While curriculum and textbook choices are in the hands of bureaucrats, it's unlikely that our school system will be results-oriented. When we change over to DVD-based programs, perhaps we'll see more courses aimed at educating kids to live and work better in the real world. No, not perhaps — it'll happen for sure.

More Mass Murder

What does it take to get you at least annoyed? The AMA, FDA, NIH, et al., all have to be well aware of the blood purifier (bioelectrifier) and the patents issued on this fast, inexpensive cure for AIDS, malaria, Lyme disease, and so on, that results when a tiny electric current is passed through the blood.

Like? How about 80,000 people died totally unnecessarily in Uganda last year from malaria ... half of them children. Or the 12 million AIDS deaths in sub-Saharan Africa last year. This is mass murder by secrecy to protect the pharmaceutical company's drug sales.

Continued on page 64

Wise Up!

Here are some of my books which can change your life (if you'll let 'em). If the idea of being healthy, wealthy and wise interests you, start reading. Yes, you can be all that, but only when you know the secrets which I've spent a lifetime uncovering.

.....Wayne

The Secret Guide to Health: Yes, there really is a secret to regaining your health and adding 30 to 60 years of healthy living to your life. The answer is simple, but it means making some serious lifestyle changes. Will you be skiing the slopes of Aspen with me when you're 90 or doddering around a nursing home? Or pushing up daisies? No, I'm not selling any health products, but I can help you cure yourself of cancer, heart trouble, or any other illness. Get this new, 2002 expanded edition (160p). $15 (#04)

The Secret Guide to Wealth: Just as with health, you'll find that you have been suckered by "the system" into a pattern of life that will keep you from ever making much money and having the freedom to travel and do what you want. I explain how anyone can get a dream job with no college, no résumé, and even without any experience. I explain how you can get someone to happily pay you to learn what you need to know to start your own business. $5 (#03)

The Secret Guide to Wisdom: This is a review of around a hundred books that will boggle your mind and help you change your life. No, I don't sell these books. They're on a wide range of subjects and will help to make you a very interesting person. Wait'll you see some of the gems you've missed reading. You'll have plenty of fascinating stuff to talk about on the air. $5 (#02)

My WWII Submarine Adventures: Yes, I spent from 1943-1945 on a submarine, right in the middle of the war with Japan. We almost got sunk several times, and twice I was in the right place at the right time to save the boat. What's it really like to be depth charged? And what's the daily life aboard a submarine like? How about the Amelia Earhart inside story? If you're near Mobile, please visit the Drum. $5 (#10)

Travel Diaries: You can travel amazingly inexpensively – once you know the ropes. Enjoy Sherry and my budget visits to Europe, Russia, and a bunch of other interesting places. How about a first class flight to Munich, a rented Audi, driving to visit Vienna, Krakow in Poland (and the famous salt mines), Prague, back to Munich, and the first class flight home for two, all for under $1,000? Yes, when you know how you can travel inexpensively, and still stay in first class hotels. $5 (#11)

Writer's Guide: It's easy, fun, can pad your résumé, and impress the hell out of your friends. $0 (#78)

Wayne's Caribbean Adventures: My super budget travel stories – where I visit the hams and scuba dive most of the islands of the Caribbean. You'll love the special Liat fare which let me visit 11 countries in 21 days, diving all but one of the islands, Guadeloupe, where the hams kept me too busy with parties. $5 (#12)

Cold Fusion Overview: This is both a brief history of cold fusion, which I predict will be one of the largest industries in the world in the 21st century, plus a simple explanation of how and why it works. This new field is going to generate a whole new bunch of billionaires, just as the personal computer industry did. $5 (#20)

Improving State Government: Here are 24 ways that state governments can cut expenses enormously, while providing far better service. I explain how any government bureau or department can cut its expenses by at least 50% in three years and do it cooperatively and enthusiastically. I explain how, by applying a new technology, the state can make it possible to provide all needed services without having to levy *any* taxes at all! Read the book, run for your legislature, and let's get busy making this country work like its founders wanted it to. Don't leave this for "someone else" to do. $5 (#30)

Mankind's Extinction Predictions: If any one of the experts who have written books predicting a soon-to-come catastrophe which will virtually wipe most of us out are right, we're in trouble. In this book I explain about the various disaster scenarios, like that of Nostradamus, who says the poles will soon shift (as they have several times in the past), wiping out 97% of mankind. Okay, so he's made a long string of past lucky guesses. The worst part of these predictions is the accuracy record of some of the experts. Will it be a pole shift, a new ice age, a massive solar flare, a comet or asteroid, a bioterrorist attack? I'm getting ready, how about you? $5 (#31)

Moondoggle: After reading René's book, *NASA Mooned America*, I read everything I could find on our Moon landings. I watched the NASA videos, looked carefully at the photos, read the astronaut's biographies, and talked with some readers who worked for NASA. This book cites 45 good reasons I believe the whole Apollo program had to have been faked. $5 (#32)

Classical Music Guide: A list of 100 CDs which will provide you with an outstanding collection of the finest classical music ever written. This is what you need to help you reduce stress. Classical music also raises youngsters' IQs, helps plants grow faster, and will make you healthier. Just wait'll you hear some of Gotschalk's fabulous music! $5 (#33)

The Radar Coverup: Is police radar dangerous? Ross Adey K6UI, a world authority, confirms the dangers of radio and magnetic fields, including our HTs and cell phones. $3 (#34)

Three Gatto Talks: A prize-winning teacher explains what's wrong with American schools and why our kids are not being educated. Why are Swedish youngsters, who start school at 7 years of age, leaving our kids in the dust? Our kids are intentionally being dumbed down by our school system — the least effective and most expensive in the world. $5 (#35)

Aspartame: a.k.a. NutraSweet, the stuff in diet drinks, etc., can cause all kinds of serious health problems. Multiple sclerosis, for one. Read all about it, two pamphlets for a buck. (#38)

$1 Million Sales Video: The secret of how you can generate an extra million dollars in sales just by using PR. This will be one of the best investments you or your business will ever make. $40 (#52)

Reprints of My Editorials from 73. Very few things in this world are as we've been taught, and as they appear. As an iconoclast I blow the whistle on the scams around us, such as the health care, our school system, our money, the drug war, a college education, sugar, the food giants, our unhealthy food, fluorides, EMFs, NutraSweet, etc.

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Colloid Reprint. April 97 article on a silver colloid maker, history, and how to use the stuff. $5 (#98)

Colloid Clips. Three 9V battery clips, 2 alligator clips & instructions. $5 (#99)

AC-powered Colloid Kit: 12V power supply, silver wires, reprint, including priority mail shipment. $37 (#82)

Four Small Booklets Combo: Super Organic Food: a trillion dollar new industry; Schools in 2020: another $ trillion industry. Anthrax, a simple cure. Dowsing: why and how it works. $3 (#86)

My 1992 **We The People Declare War! On Our Lousy Government** book—360 pages and packed with ideas that'll get you all excited. Was $13. While they last $10. Just a few left, found in the warehouse. Last chance for this classic. (#06)

Stuff I didn't write, but you need:

NASA Mooned America: René makes an air-tight case that NASA faked the Moon landings. This book will convince even you. $30 (#90)

Last Skeptic of Science: This is René's book where he debunks a bunch of accepted scientific beliefs – such as the ice ages, the Earth being a magnet, the Moon causing the tides, etc. $30 (#91)

Dark Moon: 568 pages of carefully researched proof that the Apollo Moon landings were a hoax—a capping blow for René's skeptics. $25 (#92)

1982 General Class License Study Guides. Teaches the fundamentals of radio & electricity. Was $7. I found a few in the warehouse. $3, while they last. Great book! (#83)

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The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost) — comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Hancock Rd., Peterborough NH 03458 and get set for the phone calls. The deadline for the October 2003 classified ad section is August 10, 2003.

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NEVER SAY DIE

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Well, heck, what's a bunch of Africans, right? Big deal. If we don't kill millions of 'em with AIDS and malaria, we'll soon have another billion starving mouths to feed. Name one country in Africa where there is a government that gives the slightest damn about their people. I've only visited ten African countries so far, but that was enough to give me the sorry picture.

But please don't protest abortions while ignoring the massive carnage the FDA's blood purifier secrecy blanket is allowing to go on. Your government at work.

Up in Smoke

When Big Tobacco agreed to pay the 50 states $246 billion over 25 years, the idea was for this money to be used to help educate teenagers about the stupidity of taking on a lifetime drug addiction and to help pay smokers' health care costs. Instead, the most of the $21.3 billion paid so far has been used for pork barrel projects and tax cuts, with only about 5% going for smoking prevention. Gee, what a surprise.

The Centers for Disease Control & Prevention (CDC) gives 43 of the states failing grades on providing adequate tobacco education. I know I see lots of kids smoking as they walk by our front door, going home from the high school down the road. 73

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Who said dual-banders had to be expensive? Dual band, dual watch and crossband repeat at a price that's amazingly low. CTCSS encode+decode, 50 memories per band, internal duplexer, large controls. Massive heatsink for quiet, fan-free operation. Reviewers loved this radio; you will too!

Sizzling single bands

DR-135T MkII

VHF FM Mobile/Base Transceiver

This rugged 2 meter mobile is ready for the "real world" of heavy use in demanding conditions. Whether you're chasing storms or chatting through the commute, you'll appreciate the large alphanumeric display, the big illuminated mic and the well designed functions that are easy to use. 100 memories, AM Airband receive, high stability TCXO, ignition key on/off feature, theft alarm, direct frequency input & optional internal TNC or optional internal digital voice module and more!

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